CUE 04-0050

Application for Critical Use Exemption of Methyl Bromide for Use in 2006 - 2008 for Eggplant in Georgia, USA

Made by:

Georgia Fruit and Vegetable Growers Association

August 8, 2004

Prepared by:

University of Georgia Extension Vegetable Team
Georgia Fruit and Vegetable Grower's Association

OMB Control # 2060-0482
For EPA Use Only ID # 04-0050
SECTOR GA - Eggplant

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

2004 Application for Critical Use Exemption of Methyl Bromide for Pre Plant Use in 2006 and beyond in the United States

WHY IS THIS INFORMATION NEEDED?	Under the Clean Air Act and the international treaty to protect the ozone layer (the Montreal Protocol on Substances that Deplete the Ozone Layer), the production and import of methyl bromide will be phased out in the United States on January 1, 2005. This application seeks information to support a U.S. request to produce and import methyl bromide for certain critical uses and circumstances beyond this 2005 phaseout date. The information in this application will be used to review whether your use of methyl bromide is "critical" because no technically and economically feasible alternatives are available. In order to estimate the loss as a result of not having methyl bromide available, EPA needs to compare data (yields, crops/crop groupings, prices, revenues and costs) for your use of methyl bromide with uses of alternative pest control regimens. If you submit a well documented application with sound reasons why alternatives are not technically and economically feasible, the U.S. government can be a better advocate for your exemption request internationally.

Click on the Instructions tab located at the bottom of the screen for additional information.

The information contained in this application is critical to process and assess the need for methyl bromide. Filling out this application in its entirety will bolster the U.S. government's ability to strengthen the nomination package for the international review boards.

Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information. Public reporting burden for this collection of information is estimated to average 324 hours per response and assumes a large portion of applications will be submitted by consortia on behalf of many individual users of methyl bromide. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a current OMB control number.

INSTRUCTIONS

The information provided by you in this application will be used to evaluate the requested methyl bromide use. The U.S. and other countries that are parties to the Montreal Protocol On Substances That Deplete The Ozone Layer decided that: "a use of methyl bromide should qualify as "critical" only if the nominating Party determines that:

(i) The specific use is critical because the lack of availability of methyl bromide for that use would result in a significant market disruption; and (ii) There are no technically and economically feasible alternatives available to the user that are acceptable from the standpoint of environment and health and are suitable to the crops and circumstances of the nomination ..."

WHO APPLIES?	If you anticipate that you will need methyl bromide in 2005 because you believe there are no technically and economically feasible alternatives, then you should apply for the critical use exemption. This application may be submitted either by a consortium representing multiple users or by individual users. We encourage users with similar circumstances of use to submit a single application (for example, any number of pre plant users with similar soil, pest, and climactic conditions can submit a single application.) If a consortium is applying for multiple methyl bromide users, the economic data should be for a representative or typical user within the consortium unless otherwise noted. If economic or technical factors (such as size of the farm) affecting the ability of this "representative user" to use alternatives are significantly different than other users in the consortium, more than one application should be submitted to reflect these differences. Please contact your local, state, regional or national commodity association and/or state representative agency to find out if they plan on submitting an application on behalf of your commodity group.
STATE CONTACTS	States that have agreed to participate in the exemption process are listed on EPA's website at www.epa.gov/ozone/mbr/cueqa.html
HOW DO I APPLY?	You may either complete an electronic (Microsoft Excel) or a printed version of the application. Please fill out each form or worksheet in the application as completely as possible. If you are completing the printed version and need extra space you may attach additional sheets as needed. Additional information may be available from your local state department of agriculture or at the sites listed below or by calling 1-800-296-1996.
IS MY INFORMATION CONFIDENTIAL?	The applicant may assert a business confidentiality claim covering part or all of the information in the application by placing on (or attaching to) the information, at the time it is submitted to EPA, a cover sheet, stamped or typed legend, or other suitable form of notice employing language such as trade secret, proprietary, or company confidential. Allegedly confidential portions of otherwise non-confidential documents should be clearly identified by the applicant, and may be submitted separately to facilitate identification and handling by EPA. If the applicant desires confidential treatment only until a certain date or until the occurrence of a certain event, the notice should so state. Information covered by a claim of confidentiality will be disclosed by EPA only to the extent, and by means of the procedures set forth under 40 CFR Part 2 Subpart B; 41 FR 36902, 43 FR 400000. 50 FR 51661. If no claim of confidentiality accompanies the information when it is received by EPA, it may be made available to the public by EPA without further notice to the applicant. Applicants submitting their application via e-mail assume responsibility for the confidentiality of the electronic message transmission.
WHEN IS THE INFORMATION NEEDED?	This application must be postmarked to the EPA address below no later than August 8, 2004 or 90 days after the Notice was published in the <u>Federal Register</u> requesting critical use exemption applications, whichever is later.
WHERE DO I SUBMIT THE APPLICATION?	**Electronic Address for applications:** methyl.bromide@epa.gov **(When submitting an application electronically, you should also print a hard copy, sign it, and submit it by mail)** **Mailing Address for applications being submitted by <u>mail</u> directly to the EPA:** US Environmental Protection Agency Methyl Bromide Critical Use Exemption Office of Air and Radiation Global Programs Division (6205 J) 1200 Pennsylvania Ave, NW Washington, DC 20460 **Address for applications being sent by <u>courier</u> or <u>non-U.S. Postal overnight express</u> delivery to the EPA:** US Environmental Protection Agency Methyl Bromide Critical Use Exemption Office of Air and Radiation Global Programs Division 1310 L Street, NW Washington, DC 20005 Telephone: (202) 343-9321
HOW CAN I RECEIVE ADDITIONAL INFORMATION?	***If you have general questions about this application call:*** Stratospheric Ozone Hotline 1-800-296-1996

INSTRUCTIONS

SECTIONS OF WORKBOOK	**Each worksheet number corresponds to the tab number in the electronic version of the application. *Instructions specific to each worksheet are provided at the top of each sheet. A header row is* included on each worksheet to include an application ID number that EPA will assign.**
	Instructions
	Worksheet 1. Contact and Methyl Bromide Request Information
	Worksheet 2. Methyl Bromide
	Worksheet 2-A. Methyl Bromide - Pest and Crop Information
	Worksheet 2-B. Methyl Bromide - Historical Use for 1997 - 2002
	Worksheet 2-C. Methyl Bromide - Crop/Crop Grouping Yield & Gross Revenue for 2000 - 2002
	Worksheet 2-D(1&2). Methyl Bromide - Baseline - Operating Costs for 2002 (Annual or Perennial)
	Worksheet 3. Alternatives
	Worksheet 3-A. Alternatives - Technical Feasibility of Alternatives to Methyl Bromide
	Worksheet 3-B(1&2). Alternatives - Changes in Operating Costs (Annual or Perennial)
	Worksheet 4. Future Research Plans
	Worksheet 5. Application Summary
	Definitions
	Climate Zone Map
EXCEL USER TIPS	**Inserting a blank worksheet:**
	1. To add additional blank worksheets in the Excel file, go to the menu line at the top of the worksheet and select "Insert" then "worksheet"
	2. A tab with the name "Sheet 1" will appear at the bottom of the worksheet and will be highlighted in white. Take the cursor and double click the "new tab"
	3. By double clicking in the tab you can now rename the worksheet to the appropriate number letter designation (e.g., 3-A(1), 3-A(1)(a), etc.)
	4. To move a newly inserted worksheet, simply drag the worksheet with your mouse to the desired location.
	5. Once you add a new worksheet, Excel will automatically name each subsequently added worksheet as Sheet 2, Sheet 3, etc... Follow the instructions above to rename the new blank worksheets as appropriate.
	Copying and pasting an entire worksheet's contents into a blank worksheet:
	1. Select the worksheet to be copied by clicking on the worksheet tab at the bottom of the screen. The tab will turn white in color when it has been selected.
	2. Select the top left corner of the worksheet (this is the space to the left of column A and above row 1. You will know that the entire worksheet has been selected because the row and column marks as well as the worksheet itself will
	3. Go to the menu line at the top of the worksheet and select "Edit" then "Copy".
	4. Go to the blank worksheet where you want the copied information to be pasted.
	5. Again, select the top left corner of the worksheet (left of column A and above row 1) to select the entire worksheet.
	6. Go to the menu line at the top of the worksheet and select "Edit" then "Paste"
	7. Change the title row of the newly pasted worksheet from the old worksheet number to be consistent with the worksheet tab.
	Note: This is the only way you can copy a worksheet and not lose portions of the text instructions.
	Viewing worksheets
	Worksheets are best viewed in "Page Break Preview." To select the view of the worksheet, go to the menu bar and select "View" and then "Page Break Preview." Page break preview shows only the printable area of the worksheet, with the blue lines that surround the screen indicating the edges of each page.
	To increase or decrease the size of the page that is viewable on the screen, go to the menu bar and select "View" anc then "Zoom".
	Navigating between worksheets
	The set of four arrows on the bottom left of the screen will help you navigate between worksheets. This is necessary to access the remaining worksheet tabs in the workbook that are not viewable. The two arrows with vertical lines to either the left or right will take you to the first worksheet and to the last worksheet respectively in the workbook. The inner two arrows allow you move the worksheet tabs to the right or to the left incrementally.
	The two arrows on the bottom right of the screen allow you to move the worksheet that you are viewing to the right or to the left. This is useful if the viewable area of on the screen is smaller than the entire page that is in the worksheet.
	Printing worksheets
	If you would like to print all worksheets that are contained in this workbook, go to the menu bar at the top of the screen and select "File" and then "Print." Then in the section of the menu that appears called "Print what," select "Entire Workbook."

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Worksheet 1. Contact and Methyl Bromide Request Information

The following information will be used to determine the amount of methyl bromide requested and the contact person for this request. It is important that we know whom to contact in case we need additional information during the review of the application.

Is this information Confidential Business Information? **Yes** [ ] **No** [X]
If yes, the applicant assumes responsibility for the secure transmission of electronic submissions.

Applicant Name Georgia Fruit & Vegetable Growers Association

Primary Contact

Contact Name	Charles Hall	**Specialty**	(Check One)
Address	GFVGA	**Agronomic**	[ ]
	P.O. Box 2945	**Economic**	[X]
	LaGrange, GA 30241		
Daytime Phone	877-994-3842	**Cell**	
E-mail Address	chall@asginfo.net	**Fax**	706-883-8215

Alternate Contact

Contact Name	Dr. William Terry Kelley	**Specialty**	
Address	University of Georgia	**Agronomic**	[X]
	P.O. Box 1209	**Economic**	[ ]
	Tifton, GA 31793		
Daytime Phone	229-386-3410	**Cell**	229-392-5940
E-mail Address	wtkelley@uga.edu	**Fax**	229-386-7374

I certify that all information contained in this document is factual to the best of my knowledge.

Signature William Terry Kelley **Date** 8-6-04

Print Name William Terry Kelley **Title** Ext. Hort.

Information in this application may be aggregated with information from other applications and used by the United States government to justify claims in the national nomination package that a particular use of methyl bromide be considered "critical" and authorized for an exemption beyond the 2005 phaseout. Use of aggregate data will be crucial to making compelling arguments in favor of critical use exemptions. **By signing below**, you agree now to assert any claim of confidentiality that would affect the disclosure by EPA of aggregate information based in part on information contained in this application.

Signature William Terry Kelley **Date** 8-6-04

Print Name William Terry Kelley **Title** Ext. Horticulturist

Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information. Public reporting burden for this collection of information is estimated to average 324 hours per response and assumes a large portion of applications will be submitted by consortia on behalf of many individual users of methyl bromide. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a current OMB control number.

Worksheet 1. Contact and Methyl Bromide Request Information

1. Location (Enter the state, region, or county.)

Georgia

2. Crop/Crop Grouping (Include all crops/crop groupings that benefit from an application of methyl bromide in a fumigation cycle. For a definition of fumigation cycle see Worksheet entitled "Definitions".)

Eggplant-Eggplant

3. Range of acres farmed by growers included in this application

(Insert number or percentage of users in each category)

0 - 25 acres	8%	**100 - 200 acres**	17%
25 - 50 acres	21%	**200 - 400 acres**	28%
50 - 100 acres	16%	**over 400 acres**	10%

4. Climate Zone (Indicate the climate zone designation by reviewing the U.S. climate zone map located at the end of this workbook or online at http://www.usna.usda.gov/ Hardzone/ushzmap.html.)

Zones: **1**___ **2a**____ **2b**____ **3a**____ **3b**____ **4a**____ **4b**____ **5a**____ **5b**____ **6a**____ **6b**___
(check all that apply) **7a**__X_ **7b**_X__ **8a**_X__ **8b**_X__ **9a**____ **9b**____ **10a**____ **10b**____ **11**____

5. Soil Type & Organic Matter (Indicate the soil type and percent organic matter where methyl bromide would be applied.)

(check all that apply)

Soil Type:	**Light**	X	**Medium**	X	**Heavy**	
Organic Matter:	**0 to 2 %**	X	**2 to 5 %**		**over 5 %**	

6. Is this applicant eligible for Quarantine and Preshipment (QPS) uses of methyl bromide? Yes [ ] No [X] Pounds ________

7. Has this applicant previously applied for Critical Use Exemption of methyl bromide? Yes [X] No [ ] CUE # 50

8. What is the amount of methyl bromide being requested by this application ? (Do NOT include QPS amounts)
If a consortium is submitting this application, the data should be the total for the consortium.

Year	Total Pounds Active Ingredient (a.i.) of Methyl Bromide		Total Area to be Treated	
2006	107,736	**lbs.**	804	**Acres**
2007	107,736	**lbs.**	804	**Acres**
2008	107,736	**lbs.**	804	**Acres**

9. Please explain why there may be variations in the pounds or acres treated from year to year.

10. Please explain why methyl bromide is being requested.
The current alternatives are not technically feasible to control the range of pests that must be managed to economically produce eggplant in Georgia and there is no indication that a suitable alternative can be found before 2006-2008.

11. Do you have access to recycled methyl bromide? Yes [ ] No [X] ________ **Lbs**
If yes, please specify amount (in pounds).

12. Do you anticipate that you will have any methyl bromide in storage after January 1, 2006? Yes [ ] No [X] ________ **Lbs**
If yes, please specify amount (in pounds).

Worksheet 2. Methyl Bromide

Purpose of Data: To establish a baseline estimate of crop/crop grouping yields, gross revenues, and costs using methyl bromide.

Instructions specific to each worksheet are located at the top of each sheet.

Worksheet	Title
2-A	**Methyl Bromide - Crop & Pest Information** If a consortium is submitting this application, the data for this table should reflect the **representative user** for the consortium. The purpose of this worksheet is to determine pest infestation and crop information where methyl bromide is used. This forms the baseline for evaluating the impacts of using an alternative to replace methyl bromide.
2-B	**Methyl Bromide - Historical Use 1998 - 2003** If a consortium is submitting this application, all data should reflect the **actual data** for the consortium. This worksheet provides data in actual usage for 1998-2003.
2-C	**Methyl Bromide - Crop/Crop grouping Yield and Gross Revenue for 2001-2003** If a consortium is submitting this application, the data for this table should reflect the **representative user** for the consortium. This worksheet provides crop/crop grouping yield and gross revenue for 2001 through 2003. The purpose of this worksheet is to determine past gross revenues when methyl bromide is used. This forms the baseline for evaluating the revenue impacts of using an alternative to replace methyl bromide.
2-D(1 & 2)	**Methyl Bromide - Baseline - Operating Costs for 2003** If a consortium is submitting this application, the data for this table should reflect the **representative user** for the consortium. This data is needed to estimate a baseline for operating costs in order to estimate **changes in costs** and the impact on operating profit and short-run economic viability as a result of not using methyl bromide and to provide required information to the international review board. The purpose of this worksheet is to determine operating expenses when methyl bromide is used. This forms the baseline for evaluating the cost impacts of using an alternative to replace methyl bromide. The data requested are designed to help you identify how your operation would change if methyl bromide were unavailable, which will be shown in Worksheet 3-B. Worksheet 2-D(1) is for users with a fumigation cycle of less than 5 years. Worksheet 2-D(2) is for users growing perennial crops following a single fumigation at establishment. **In collaboration with USDA, we will estimate fixed and overhead costs across crops and regions to ensure consistency within the U.S. nomination.**

Worksheet 2-A. Methyl Bromide - Crop & Pest Information

1. Crop/Crop Grouping or Consortium Eggplant-Eggplant

2. Which month does your fumigation cycle start? (check only one)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
						X					

2. Fumigation and Crop Timeline

(**Indicate when fumigation, major crop and pest management practices typically occur by shading the appropriate cells.** Show a second crop if part of the fumigation cycle. If the fumigation cycle is longer than one year change the months to an appropriate interval. These tables are for annual crops but more than one crop may benefit from one methyl bromide fumigation. If application covers multiple crops/crop groupings not grown sequentially, they will need to provide this information for all crops/crop groupings. Please adjust timeline as necessary. **Please provide additional comments or description below or on a separate page.** Please begin the timeline with the first land preparation. For **perennials**, please begin with the **year** of land preparation and fumigation and indicate the years of production by yield or percentage of full production.)

Beginning Fumigation Cycle	Time Interval (e.g. MONTH/YEAR/SEASON)											
	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Land Preparation	X											
Fumigation	X											
Planting	X								X			
Harvest				X	X						X	X
Fallow						X	X					
Other Key Crop Steps								X				
Other Key Pest Steps								X				

Continuation of Fumigation Cycle (if needed)	Time Interval (e.g. MONTH/YEAR/SEASON)											
	Month 13	Month 14	Month 15	Month 16	Month 17	Month 18	Month 19	Month 20	Month 21	Month 22	Month 23	Month 24
Land Preparation												
Fumigation												
Planting												
Harvest	X											
Fallow												
Other Key Crop Steps												
Other Key Pest Steps												

Comments:

Eggplant can be followed by a cucurbit crop such as cucumbers. Other crops that might be planted following eggplant would be squash, cabbage, bell pepper or another crop of eggplant. The grower is thus able to get at least two crops from the field for each fumigation event.
Sometimes, growers will ratoon the spring crop of eggplant after harvest and let it come back for a second crop.
Fumigation takes place in the spring or fall. A fall application cycle is shown in this application.
Crops are fertilized through drip irrigation and fungicides and insecticides are applied as needed.

Worksheet 2-A. Methyl Bromide - Crop & Pest Information

3. Target Pest(s) or Pest Problem(s): (Please identify the top target pests or pest problems. Provide at least common name and genus and species if possible. Additional pests or pest problems can be provided as an attachment.)

	Common Name	Genus	
Pest 1	Yellow and Purple Nutsedge	*Cyperus esculentus*	*Cyperus rotundus*
Pest 2	Crown and Root Rot	Phytophthora capsici	
Pest 3	Nematodes	Meloidogyne incognita	Pratylenchus sp.
Pest 4	Southern Blight	Sclerotium rolfsii	
Pest 5	Pythium root and collar rot	P. irregulare, myriotylum	P. ultimum, aphanadermatum

4. Pest Economic Threshold (Please provide the economic threshold information for each pest. Describe year and source of information such as survey or expert estimate.)

	Threshold	**Units** (e.g. pests/sq ft)	Year	Source
Pest 1	Treat if present.	1	2003	Dr. Stanley Culpepper
Pest 2	Treat if present.	1	2003	Dr. David B. Langston, Jr.
Pest 3	Treat if present.	1	2003	Dr. David B. Langston, Jr.
Pest 4	Treat if present.	1	2003	Dr. David B. Langston, Jr.
Pest 5	Treat if present.	1	2003	Dr. David B. Langston, Jr.

5. Target Pest Infestation (Please estimate the percentage of the consortia's total growing area with a moderate to severe problem with these pests. Describe source of information such as a survey or expert estimate.)

	Percentage of Total Growing Area		Source
Pest 1	100	%	Dr. Stanley Culpepper-Extension Weed Scientist-Univ. of GA
Pest 2	40	%	Dr. David B. Langston, Jr.-Extension Plant Pathologist-UGA
Pest 3	70	%	Dr. David B. Langston, Jr.-Extension Plant Pathologist-UGA
Pest 4	70	%	Dr. David B. Langston, Jr.-Extension Plant Pathologist-UGA
Pest 5	100	%	Dr. David B. Langston, Jr.-Extension Plant Pathologist-UGA

6. Representative User : *(Please provide descriptive factors regarding your operation.)*

Average Farm Size 500 **Acres**

Average acres in **this** crop 50 **Acres**

Average Area Treated with Methyl Bromide: 300 **Acres**

Describe a few crops that could follow **this** crop: Cucumbers; Squash; Bell Pepper; Eggplant

Other descriptive factors regarding representative user:

The representative user will generally grow several different commodities and will rent or lease approximately 50% of the land he/she farms. The user will generally grow two or three crops on the same land each year to complete one fumigation cycle. The user will treat with methyl bromide on a regular basis since pest pressure will always be high.

The grower may complete two, three or even four crops in one fumigation cycle.

Worksheet 2-B. Methyl Bromide - Historical Use for 1998-2003

Column A:	**Total Actual Pounds a.i. of Methyl Bromide Applied per Year** Enter the total actual pounds active ingredient (a.i.) of methyl bromide applied. Note: This number should *be the total pounds a.i. applied by the individual user or the entire consortium, for the year indicated.* Include only the pounds active ingredient of methyl bromide. Do not include the pounds of chloropicrin that may be part of the same product.
Column B:	**Total Actual Acres Treated per Year** Enter the total actual acres treated. Note: This number should be the total actual acres treated by the individual user or total actual acres treated for the entire consortium, for the year indicated. For furrow treatment the acres should include the area between the rows as well as the area of the rows. i.e. acres treated is the area of the cultivated fields being treated including the area between rows even if they are not treated.
Column C:	**Average Pounds a.i. Applied per Area per Year** The average application rates in pounds a.i. of methyl bromide per area may be calculated by dividing Column A by Column B.

	A	B	C
Year	**Total Actual Pounds a.i. of Methyl Bromide Applied per Year**	**Total Actual Acres Treated per Year**	**Average Pounds a.i. Applied per Acre per Year**
1998	**91,287**	414	220.5
1999	**105,212**	619	170.2
2000	**110,282**	823	134
2001	**104,252**	778	134
2002	**106,128**	792	134
2003	**114,570**	855	134

What is the frequency of methyl bromide applied per area? (1x / year, 2x / year, 1x / 3 years, etc.)

____1_____ times per ____year______

If there is a variation (greater than 10%) in the quantity a.i., the acres treated or average application rate from year to year, please explain the reasons for the variation.

Eggplant acreage tends to fluctuate with price swings. However, there has been a general increase in acreage in the last few years. Since many eggplant growers also grow other vegetables, they may adjust their acres of eggplant according to acres of other vegetables produced. There has been a shift to 67% MBr in the last few years and reduction in rate as price has increased.

Comments:

Worksheet 2-C. Methyl Bromide - Crop/Species Yield & Gross Revenue for 2001-2003

Column A: Year

Be sure to enter the year. Use as many rows as needed for each year for all the crops/crop groupings in the fumigation cycles from 2001 to 2003. If a fumigation cycle overlaps more than one calendar year, then the year of the fumigation cycle is the year methyl bromide was applied.

Column B: Crops/Crop Groupings

Enter all crops/crop groupings that benefit from methyl bromide in the fumigation cycle. If multiple crops/crop groupings are grown during the interval between fumigations (e.g. tomatoes followed by peppers in a single growing season, or strawberries followed by lettuce over 2 or 3 years) include all of the crops/crop groupings during the entire interval.

If someone other than the applicant benefits from the application of methyl bromide in the fumigation cycle and you do not have the quantitative data for the crops/crop groupings grown on the same land, please indicate so in the comments section below.

Column C: Market Categories

Enter marketing categories that determine prices received, for example, grade (size, color), timeliness (early season, late season), or end use (fresh, processing). Itemize or aggregate these factors to the extent appropriate if lack of methyl bromide would effect the yields in each category.

Column D: Yield

Enter the yield per acre, or the proportion of total yields, obtained for that category. For perennial crops, please enter yields at full production. Be sure to indicate yields at other stages in the timeline in Worksheet 2-A.

Column E: Units of Measurement

Enter the unit of measurement for each crop/species (lbs, cwt, carton, bin). If not by weight, specify in the comments section the average weight of the measure.

Column F: Price

Enter average prices received by the users for that crop/crop grouping and market category. Average price over all categories can be calculated separately, if needed.

Column G: Gross Revenue

Gross revenue per acre for each market category and or each crop/crop grouping may be calculated using the data you entered as price times yield. If revenue is not equal to price times yield, you may enter a different revenue amount, but please explain the difference in the comments section below.

A	B	C	D	E	F	G
Year	**Crops/Crop Groupings**	**Market Category**	**Yield**	**Unit of Measurement**	**Price ($)**	**Gross Revenue per Acre ($)**
2001	**Eggplant**	Fresh Market	1133	**1 1/9 bu carton**	$ 5.22	$ 5,914.26
2002	**Eggplant**	Fresh Market	1250	**1 1/9 bu carton**	$ 5.74	$ 7,175.00
2002	**Eggplant**	Fresh Market	1120	**1 1/9 bu carton**	$ 5.78	$ 6,473.60
2003	**Eggplant**	Fresh Market	1085	**1 1/9 bu carton**	$ 7.91	$ 8,582.35
2003	**Eggplant**	Fresh Market	1950	**1 1/9 bu carton**	$ 7.42	$ 14,469.00
2004	**Eggplant**	Fresh Market	2050	**1 1/9 bu carton**	$ 4.71	$ 9,655.50

If this application is for multiple crops/crop groupings (e.g. nurseries producing evergreens, deciduous, and forbs) please indicate the proportion of land area allocated to each crop/crop grouping.

Comments:

Since the fumigation cycle starts in the fall, the second crop is always a spring crop in the following year.

Worksheet 2-D(1). Methyl Bromide - Baseline - Operating Costs for 2003

Enter all operating costs incurred during a fumigation cycle. Users with a relatively short fumigation cycle (less than five years) should use version D(1); users cultivating perennial crops should use version D(2). Users with multiple crops, either on the same area in a single fumigation cycle or on different areas treated separately, should copy this sheet and provide costs for each crop. If multiple crops are cultivated sequentially following a single fumigation, replace fumigation costs in Pre-plant Operations with any additional pest control costs used prior to the following crops. If a fallow season is an important part of the fumigation cycle, include costs incurred (for example, cultivating a cover crop) as a separate line or as a separate sheet, if costs are extensive. **Please fill in the unshaded areas. The shaded areas can be used if the information is known.**

Column A:	**Operation / Input** The operations/inputs listed here are not meant to be exhaustive or representative of your specific production system. They are meant to provide suggestions and to help you identify how your operation would change if methyl bromide were unavailable. Be as precise as necessary otherwise you may aggregate operations or inputs. For example, specify herbicide costs if additional treatments would become necessary with the use of a methyl bromide alternative, otherwise you may simply specify total pesticide costs. **Please specify only variable operating costs.**
	Operation / Input for Perennial Crops For perennial crops (Worksheet D(2)), we have divided the lifespan into three basic periods: pre-production (including establishment), initial production, and full production. Please ensure that the timeline in Worksheet 2-A indicates the years of each period. Operating costs should be an average of costs incurred during each period. Please consider expected replanting rates and indicate which year dead or poorly performing young trees would be replaced. You may copy columns/rows as needed if these periods need to be refined for your situation.
Column B:	**Quantity Used per Acre** This field is required only for methyl bromide. However, you may include specific amounts of other inputs or operations if you believe it helps to document the additional costs you would incur by using an alternative fumigant.
	Constant Cost per Acre For harvest operations, specify costs that depend on land area, for example, picking costs, per acre of land.
Column C:	**Units** For all inputs and operations detailed in Column B, please specify the units of measurement.
	Cost per Unit of Yield For harvest operations, specify costs that depend on amount of product harvested, for example, packing material, per unit of produce.
Column D:	**Unit Costs** For all inputs and operations detailed in Column B, please specify the unit cost. Also, indicate all costs of applying methyl bromide, including any material costs, for example, tarps. If custom applied and separate costs are unavailable, write 'custom' and enter total cost in Column E.
	Yield For harvest operations, indicate average yields or representative yields from Worksheet 2-C.
Column E:	**Total Cost per Acre** For inputs and operations detailed in Columns B and D, total costs can be calculated as Column B times Column D. Otherwise, enter total cost of the input or operation. **As a check, you may add up Column E to obtain an estimate of total variable operating costs. These will not include fixed and overhead costs, nor a return to the owners' labor. It should, therefore, be less than gross revenues calculated in Worksheet 2-C. If it is not, please explain (for example, unusually poor yields or unusually poor prices).** For perennial crops, Column E should only be totaled for the years at full production.
	Total Cost per Acre Harvest costs may likewise be calculated as costs per acre (Column B) plus variable costs per unit of yield (Column C) times yield (Column D).

Worksheet 2-D(1a). Methyl Bromide - Baseline - Operating Costs for 2003 - Eggplant

A	B	C	D	E
Operation / Input	**Quantity Used per Acre**	**Units (lbs, hours, etc)**	**Unit Cost ($)**	**Total Cost per Acre ($)**
Pre-plant Operations				
Land preparation				$ 50.00
Fumigation				
product (methyl bromide)	200 pounds	lbs/acre	$ 2.65	$ 530.00
application				$ 250.00
Irrigation				$ 50.00
Other costs				$ 415.58
Cultural Operations				
Seed / Seedlings				$ 185.00
Fertilizer / Soil Amendments				$ 255.88
Pesticides				
Insecticide				$ 172.70
Herbicide				$ 47.85
Fungicide				$ 310.20
Nematicide				
Irrigation				$ 250.00
Labor (manual)				$ 137.25
Fuel / Machine Labor				$ 35.17
Other Costs (Staking and Tying)				$ 389.09
Interest on Operating Capital (9%)				$ 277.08
Total				$ 3,355.80
Harvest Operations	**Constant Cost per Acre ($)**	**Cost per Unit of Yield ($)**	**Yield**	**Total Cost per Acre ($)**
Labor		$ 0.13	1,950.00	$ 253.50
Hauling		$ 0.68	1,950.00	$ 1,326.00
Material		$ 0.80	1,950.00	$ 1,560.00
Grading / Packing / Storage		$ 1.69	1,950.00	$ 3,295.50
Other Costs				
Marketing (8.5%)				$ 1,229.87
Total				$ 7,664.87

Worksheet 2-D(1b). Methyl Bromide - Baseline - Operating Costs for 2003 - Eggplant (2nd Crop)

A	B	C	D	E
Operation / Input	**Quantity Used per Acre**	**Units (lbs, hours, etc)**	**Unit Cost ($)**	**Total Cost per Acre ($)**
Pre-plant Operations				
Land preparation				$ 9.75
Fumigation				
product (vapam between crops)	25	gallons/acre	$ 3.75	$ 93.75
application				$ 25.00
Irrigation				$ 50.00
Other costs				
Cultural Operations				
Seed / Seedlings				$ 185.00
Fertilizer / Soil Amendments				$ 232.88
Pesticides				
Insecticide				$ 172.70
Herbicide				$ 47.85
Fungicide				$ 310.20
Nematicide				
Irrigation				$ 250.00
Labor (manual)				$ 137.25
Fuel / Machine Labor				$ 35.17
Other Costs (Staking/Tying)				$ 95.94
Interest on Operating Capital (9%)				$ 148.09
Total				$ 1,793.58
Harvest Operations	**Constant Cost per Acre ($)**	**Cost per Unit of Yield ($)**	**Yield**	**Total Cost per Acre ($)**
Labor		$ 0.13	2,050.00	$ 266.50
Hauling		$ 0.68	2,050.00	$ 1,394.00
Material		$ 0.80	2,050.00	$ 1,640.00
Grading / Packing / Storage		$ 1.69	2,050.00	$ 3,464.50
Other Costs				
Marketing Costs (8.5%)				$ 820.72
				$ 7,585.72
Total				

Worksheet 3. Alternatives - Feasibility of Alternative Pest Control Regimens

Purpose of Data: To estimate the loss as a result of not having methyl bromide available. EPA needs to compare data (yields, crop/species prices, gross revenues and costs) on the use of methyl bromide and alternative pest control regimens.
Complete worksheet 3-A for each alternative pest control regimen listed in the "U.S. Matrix" for chemical controls (www.epa.gov/ozone/mbr/cueqa.html) and the "International Matrix" for non-chemical pest controls (www.epa.gov/ozone/mbr/cue). Each worksheet contains a place holder in the title for you to insert the name of the specific alternative pest control regimen addressed. You should add additional worksheets as required.
Enter all alternative pesticides and pest control methods (and associated cost and yield data) that would replace one treatment of methyl bromide throughout the fumigation cycle. See the Definition worksheet for a comprehensive definition on fumigation cycles.

Worksheet	Title
3-A	**Alternatives - Technical Feasibility of Alternatives to Methyl Bromide** You must complete one worksheet for each alternative. Please inset the name of the alternative in the area on top of the page. If you prefer, you may provide the information requested in this worksheet in a narrative review. However, you must fill in the information in Question #1 and #3 or we will assume no yield or quality loss.
3-B	**Alternatives - Changes in Operating Costs** If a consortium is submitting this application, the data for this table should reflect the **representative user** for the consortium. This data is needed to estimate **changes in costs** and the impact on operating profit and short-run economic viability as a result of not using methyl bromide and to provide required information to the international review board. **Please fill out this worksheet for each alternative specified in the U.S. Matrix and for other alternatives for which the economic evaluation would bolster the case that methyl bromide is needed.** The purpose of this worksheet is to determine operating expenses when alternatives are used for evaluating the cost impacts of using an alternative to replace methyl bromide. The data requested are designed to help you identify how your operation would change if methyl bromide were unavailable. Worksheet 3-B(1) is for users with a fumigation cycle of less than 5 years. Worksheet 3-B(2) is for users growing perennial crops following a single fumigation at establishment. **In collaboration with USDA, we will estimate fixed and overhead costs across crops and regions to ensure consistency within the U.S. nomination.**

Worksheet 3-A (1). Alternatives - Technical Feasibility of Alternatives to Methyl Bromide

Alternative: 1, 3-dichloropropene

1. Yield Loss & Pest Control When Comparing This Alternative to Methyl Bromide

Provide numerical estimates where possible.

Study # (list below)	Pest Being Tested	% Yield Loss *	% Pest Control *	Details
1	*Cyperus* Sp.	30-40	0	Feasibility covered in previous applications and attached studies.
2				
3				
4				
5				
Enter Average Loss				

* If no yield or quality loss information is given we will assume no losses. Only provide pest control information if yield or quality loss information is not available.

2. Study Information

For the information in #1 above list: the study name, authors, publication, date, and if a copy is attached.

Study #	Attached?	Details
1		see 2005 & 2006 applications
2	X	Cucumber Growth and Yield in Response to Halsulfuron
3	X	Infestation of Nutsedge Species in Georgia Vegetable Crops During 2003
4	X	Fumigant/Herbicide Combinations
5		

3. Quality Loss *

Describe quality impacts such as: percent smaller fruit, reduced grade, smaller plants, crop damage, disease vector, etc. **Refer to market category question in Worksheet 2-C.**

Market Category	Yield with Methyl Bromide	Units	Yield With Alternative	Units	Quality Impact Description
Fresh Mkt-Eggplant	1950	bu	1365	bu	later harvest, smaller fruit
Fresh Mkt-Eggplant	2050	bu	1230	bu	smaller fruit

4. Are there any production delays (planting/ harvesting) associated with this alternative?

Yes [X] No [ ] (If yes, please explain) Label requires 28-day waiting period before planting.

5. Are there any variety or cultivar issues associated with this alternative?

6. Restrictions on Alternative Use

This information will be used to determine the amount of methyl bromide needed.

	% of Area	Details
Regulatory Restriction		
- Label Restriction	**100**	**28-day waiting period from application to planting**
- Township Caps		
Soil Restriction	**8**	**Cannot be used over Karst topography/geology**
Pest Resistant To Alternative		
Organic Matter Restriction		
Off Site Damage (outgassing)		
Other Restrictions (Describe)		

Worksheet 3-A(1). Alternatives - Technical Feasibility of Alternatives to Methyl Bromide

Alternative: 1, 3-dichloropropene

7. Use Rate of Chemical Alternative

Active Ingredient (a.i.)	Name of Product and Formulation	Quantity a.i. per Acre	Units (gals, lbs. Etc.)	# of Acres Treated	# of Applications per Year
1, 3-dichloropropene	Telone II	88.6-118.0	lbs.	NA	1
1, 3-D +chloropicrin	In-Line	85.4-135	lbs.	NA	1 to 2
1, 3-dichloropropene	Telone EC	85-170	lbs.	NA	1 to 2
1, 3-D +chloropicrin	Telone C-35	88.9-140	lbs.	NA	1

8. Non-Chemical Pest Control (please describe)

9. Alternative Timeline

(**Indicate when fumigation, major crop and pest management practices typically occur by shading the appropriate cells.** Show a second crop if part of the fumigation cycle. If the fumigation cycle is longer than one year change the months to an appropriate interval. These tables are for annual crops but more than one crop may benefit from one methyl bromide fumigation. If application covers multiple crops/crop groupings not grown sequentially, they will need to provide this information for all crops/crop groupings. Please adjust timeline as necessary. **Please provide additional comments or description below or on a separate page.** Please begin the timeline with the first land preparation. For **perennials**, please begin with the **year** of land preparation and fumigation and indicate the years of production by yield or percentage of full production.)

Beginning Fumigation Cycle	Time Interval (e.g. MONTH/YEAR/SEASON)											
	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Land Preparation	X											
Fumigation	X											
Planting		X							X			
Harvest				X	X						X	X
Fallow						X	X					
Other Key Crop Steps								X				
Other Key Pest Steps								X				

Continuation of Alternative Cycle (if needed)	Time Interval (e.g. MONTH/YEAR/SEASON)											
	Month 13	Month 14	Month 15	Month 16	Month 17	Month 18	Month 19	Month 20	Month 21	Month 22	Month 23	Month 24
Land Preparation												
Fumigation												
Planting												
Harvest	X											
Fallow												
Other Key Crop Steps												
Other Key Pest Steps												

Comments:

First crop is terminated and a burndown herbicide plus Metam Sodium through drip irrigation may be applied between crops.

Reference for yield loss information: Weed Tech. 16:860-866. Data for cantaloupe, but would likely be greater for eggplant.

Worksheet 3-B(1). Alternatives - Changes in Operating Costs

Alternative: 1, 3-dichloropropene/Eggplant

Enter all operating costs incurred during a fumigation cycle. Users with a relatively short fumigation cycle (less than five years) should use version B(1); users cultivating perennial crops should use version B(2). Users with multiple crops, either on the same area in a single fumigation cycle or on different areas treated separately, should copy this sheet and provide costs for each crop. If multiple crops are cultivated sequentially following a single fumigation, replace fumigation costs in pre plant Operations with any additional pest control costs used prior to the following crops. If a fallow season is an important part of the fumigation cycle, include costs incurred (for example, cultivating a cover crop) as a separate line or as a separate sheet, if costs are extensive. **Please fill in the unshaded areas. The shaded areas can be used if the information is known.**

Column A:	**Operation / Input** The operations/inputs listed here are not meant to be exhaustive or representative of your specific production system. They are meant to provide suggestions and to help you identify how your operation would change if methyl bromide were unavailable. Be as precise as necessary otherwise you may aggregate operations or inputs. For example, specify herbicide costs if additional treatments would become necessary with the use of a methyl bromide alternative, otherwise you may simply specify total pesticide costs. **Please specify only variable operating costs.**
	Operation / Input for Perennial Crops For perennial crops (Worksheet B(2)), we have divided the lifespan into three basic periods: pre-production (including establishment), initial production, and full production. Please ensure that the timeline in Worksheet 3-A indicates the years of each period. Operating costs should be an average of costs incurred during each period. Please consider expected replanting rates and indicate which year dead or poorly performing young trees would be replaced. You may copy columns/rows as needed if these periods need to be refined for your situation.
Column B:	**Quantity Used per Acre** This field is required only for methyl bromide. However, you may include specific amounts of other inputs or operations if you believe it helps to document the additional costs you would incur by using an alternative fumigant.
	Constant Cost per Acre For harvest operations, specify costs that depend on land area, for example, picking costs, per acre of land.
Column C:	**Units** For all inputs and operations detailed in Column B, please specify the units of measurement.
	Cost per Unit of Yield For harvest operations, specify costs that depend on amount of product harvested, for example, packing material, per unit of produce.
Column D:	**Unit Costs** For all inputs and operations detailed in Column B, please specify the unit cost. Also, indicate all costs of applying methyl bromide, including any material costs, for example, tarps. If custom applied and separate costs are unavailable, write 'custom' and enter total cost in Column E.
	Yield For harvest operations, indicate average yields or representative yields from Worksheet 3-A.
Column E:	**Total Cost per Acre** For inputs and operations detailed in Columns B and D, total costs can be calculated as Column B times Column D. Otherwise, enter total cost of the input or operation. As a check, you may add up Column E to obtain an estimate of total variable operating costs. These will not include fixed and overhead costs, nor a return to the owners' labor. It should, therefore, be less than gross revenues calculated in Worksheet 2-C. If it is not, please explain (for example, unusually poor yields or unusually poor prices). For perennial crops, Column E should only be totaled for the years at full production.
	Total Cost per Acre Harvest costs may likewise be calculated as costs per acre (Column B) plus variable costs per unit of yield (Column C) times yield (Column D).

Worksheet 3-B(1a). Alternatives - Changes in Operating Costs

Alternative: 1, 3-dichloropropene/Eggplant

A	B	C	D	E
Operation / Input	Quantity Used per Acre	Units (lbs, hours, etc)	Unit Cost ($)	Total Cost per Acre ($)
Pre-plant Operations				
Land preparation				$ 50.00
Fumigation				
product (methyl bromide)	17.5	gallons	$ 21.00	$ 367.50
application				$ 250.00
Irrigation				$ 50.00
Other costs				$ 415.58
Cultural Operations				
Seed / Seedlings				$ 185.00
Fertilizer / Soil Amendments				$ 255.88
Pesticides				
Insecticide				$ 172.70
Herbicide				$ 99.60
Fungicide				$ 310.20
Nematicide				$ 138.60
Irrigation				$ 250.00
Labor (manual)				$ 222.53
Fuel / Machine Labor				$ 35.17
Other Costs (Staking and Tying)				$ 389.09
Interest on Operating Capital (9%)				$ 287.27
Total				$ 3,479.12
Harvest Operations	Constant Cost per Acre ($)	Cost per Unit of Yield ($)	Yield	Total Cost per Acre ($)
Labor		$ 0.13	1,365.00	$ 177.45
Hauling		$ 0.68	1,365.00	$ 928.20
Material		$ 0.80	1,365.00	$ 1,092.00
Grading / Packing / Storage		$ 1.69	1,365.00	$ 2,306.85
Other Costs				
Marketing Costs (8.5%)				$ 860.91
				$ 5,365.41
Total				

Worksheet 3-B(1b). Alternatives - Changes in Operating Costs

Alternative: 1, 3-Dichloropropene-Eggplant (2nd Crop)

A	B	C	D	E
Operation / Input	**Quantity Used per Acre**	**Units (lbs, hours, etc)**	**Unit Cost ($)**	**Total Cost per Acre ($)**
Pre-plant Operations				
Land preparation				$ 9.75
Fumigation				
product (vapam between crops)	25	gallons/acre	$ 3.75	$ 93.75
application				$ 25.00
Irrigation				$ 50.00
Other costs				
Cultural Operations				
Seed / Seedlings				$ 185.00
Fertilizer / Soil Amendments				$ 232.88
Pesticides				
Insecticide				$ 172.70
Herbicide				$ 61.77
Fungicide				$ 392.70
Nematicide				$ 138.60
Irrigation				$ 250.00
Labor (manual)				$ 222.53
Fuel / Machine Labor				$ 35.17
Other Costs (Staking and Tying)				$ 95.94
Interest on Operating Capital (9%)				$ 176.92
Total				$ 2,142.71
Harvest Operations	**Constant Cost per Acre ($)**	**Cost per Unit of Yield ($)**	**Yield**	**Total Cost per Acre ($)**
Labor		$ 0.13	1,230.00	$ 159.90
Hauling		$ 0.68	1,230.00	$ 836.40
Material		$ 0.80	1,230.00	$ 984.00
Grading / Packing / Storage		$ 1.69	1,230.00	$ 2,078.70
Other Costs				
Marketing Costs (8.5%)				$ 492.43
Total				$ 4,059.00

Worksheet 3-A (2). Alternatives - Technical Feasibility of Alternatives to Methyl Bromide

Alternative: Metam Sodium/Metam Potassium

1. Yield Loss & Pest Control When Comparing This Alternative to Methyl Bromide

Provide numerical estimates where possible.

Study # (list below)	Pest Being Tested	% Yield Loss *	% Pest Control *	Details
1	Cyperus Sp.	30-40	0	Feasibility covered in previous applications.
2				
3				
4				
5				
Enter Average Loss				

* If no yield or quality loss information is given we will assume no losses. Only provide pest control information if yield or quality loss information is not available.

2. Study Information

For the information in #1 above list: the study name, authors, publication, date, and if a copy is attached.

Study #	Attached?	Details
1		see 2005 & 2006 applications
2	X	Cucumber Growth and Yield in Response to Halsulfuron
3	X	Infestation of Nutsedge Species in Georgia Vegetable Crops During 2003
4	X	Fumigant/Herbicide Combinations
5		

3. Quality Loss *

Describe quality impacts such as: percent smaller fruit, reduced grade, smaller plants, crop damage, disease vector, etc. **Refer to market category question in Worksheet 2-C.**

Market Category	Yield with Methyl Bromide	Units	Yield With Alternative	Units	Quality Impact Description
Fresh Mkt-Eggplant	1950	bu	1365	bu	later harvest, smaller fruit
Fresh Mkt-Eggplant	2050	bu	1230	bu	smaller fruit

4. Are there any production delays (planting/ harvesting) associated with this alternative?

Yes [X] No [ ] (If yes, please explain) Label requires 21-day waiting period before planting.

5. Are there any variety or cultivar issues associated with this alternative?

6. Restrictions on Alternative Use

This information will be used to determine the amount of methyl bromide needed.

	% of Area	Details
Regulatory Restriction		
- Label Restriction	100	21-day waiting period from application to planting
- Township Caps		
Soil Restriction		
Pest Resistant To Alternative		
Organic Matter Restriction		
Off Site Damage (outgassing)		
Other Restrictions (Describe)		

Worksheet 3-A(2). Alternatives - Technical Feasibility of Alternatives to Methyl Bromide

Alternative: Metam Sodium/Metam Potassium

7. Use Rate of Chemical Alternative

Active Ingredient (a.i.)	Name of Product and Formulation	Quantity a.i. per Acre	Units (gals, lbs. Etc.)	# of Acres Treated	# of Applications per Year
Metam Sodium	Vapam/Sectagon	160-320	lbs.		1 to 2
Metam Potassium	K-Pam	174-348	lbs.		1 to 2

8. Non-Chemical Pest Control (please describe)

9. Alternative Timeline (**Indicate when fumigation, major crop and pest management practices typically occur by shading the appropriate cells.** Show a second crop if part of the fumigation cycle. If the fumigation cycle is longer than one year change the months to an appropriate

Beginning Fumigation Cycle	Time Interval (e.g. MONTH/YEAR/SEASON)											
	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Land Preparation	X											
Fumigation	X											
Planting		X							X			
Harvest				X	X						X	X
Fallow						X	X					
Other Key Crop Steps								X				
Other Key Pest Steps								X				

Continuation of Alternative Cycle (if needed)	Time Interval (e.g. MONTH/YEAR/SEASON)											
	Month 13	Month 14	Month 15	Month 16	Month 17	Month 18	Month 19	Month 20	Month 21	Month 22	Month 23	Month 24
Land Preparation												
Fumigation												
Planting												
Harvest	X											
Fallow												
Other Key Crop Steps												
Other Key Pest Steps												

Comments:

First crop is terminated and a burndown herbicide plus Metam Sodium through drip irrigation may be applied between crops.

Reference for yield loss information: Weed Tech.16:860-866. Data for cantaloupe, but would likely be greater with eggplant.

Worksheet 3-B(2). Alternatives - Changes in Operating Costs

Alternative: Metam Sodium-Metam Potassium/Eggplant

Enter all operating costs incurred during a fumigation cycle. Users with a relatively short fumigation cycle (less than five years) should use version B(1); users cultivating perennial crops should use version B(2). Users with multiple crops, either on the same area in a single fumigation cycle or on different areas treated separately, should copy this sheet and provide costs for each crop. If multiple crops are cultivated sequentially following a single fumigation, replace fumigation costs in pre plant Operations with any additional pest control costs used prior to the following crops. If a fallow season is an important part of the fumigation cycle, include costs incurred (for example, cultivating a cover crop) as a separate line or as a separate sheet, if costs are extensive. **Please fill in the unshaded areas. The shaded areas can be used if the information is known.**

Column A:	**Operation / Input** The operations/inputs listed here are not meant to be exhaustive or representative of your specific production system. They are meant to provide suggestions and to help you identify how your operation would change if methyl bromide were unavailable. Be as precise as necessary otherwise you may aggregate operations or inputs. For example, specify herbicide costs if additional treatments would become necessary with the use of a methyl bromide alternative, otherwise you may simply specify total pesticide costs. **Please specify only variable operating costs.**
	Operation / Input for Perennial Crops For perennial crops (Worksheet B(2)), we have divided the lifespan into three basic periods: pre-production (including establishment), initial production, and full production. Please ensure that the timeline in Worksheet 3-A indicates the years of each period. Operating costs should be an average of costs incurred during each period. Please consider expected replanting rates and indicate which year dead or poorly performing young trees would be replaced. You may copy columns/rows as needed if these periods need to be refined for your situation.
Column B:	**Quantity Used per Acre** This field is required only for methyl bromide. However, you may include specific amounts of other inputs or operations if you believe it helps to document the additional costs you would incur by using an alternative fumigant.
	Constant Cost per Acre For harvest operations, specify costs that depend on land area, for example, picking costs, per acre of land.
Column C:	**Units** For all inputs and operations detailed in Column B, please specify the units of measurement.
	Cost per Unit of Yield For harvest operations, specify costs that depend on amount of product harvested, for example, packing material, per unit of produce.
Column D:	**Unit Costs** For all inputs and operations detailed in Column B, please specify the unit cost. Also, indicate all costs of applying methyl bromide, including any material costs, for example, tarps. If custom applied and separate costs are unavailable, write 'custom' and enter total cost in Column E.
	Yield For harvest operations, indicate average yields or representative yields from Worksheet 3-A.
Column E:	**Total Cost per Acre** For inputs and operations detailed in Columns B and D, total costs can be calculated as Column B times Column D. Otherwise, enter total cost of the input or operation. As a check, you may add up Column E to obtain an estimate of total variable operating costs. These will not include fixed and overhead costs, nor a return to the owners' labor. It should, therefore, be less than gross revenues calculated in Worksheet 2-C. If it is not, please explain (for example, unusually poor yields or unusually poor prices). For perennial crops, Column E should only be totaled for the years at full production.
	Total Cost per Acre Harvest costs may likewise be calculated as costs per acre (Column B) plus variable costs per unit of yield (Column C) times yield (Column D).

Worksheet 3-B(2a). Alternatives - Changes in Operating Costs

Alternative: Metam Sodium/Metam Potassium/Eggplant

A	B	C	D	E
Operation / Input	**Quantity Used per Acre**	**Units (lbs, hours, etc)**	**Unit Cost ($)**	**Total Cost per Acre ($)**
Pre-plant Operations				
Land preparation				$ 50.00
Fumigation				
product (metam sodium)	75	gallons	$ 3.75	$ 281.25
application				$ 250.00
Irrigation				$ 50.00
Other costs				$ 415.58
Cultural Operations				
Seed / Seedlings				$ 185.00
Fertilizer / Soil Amendments				$ 255.88
Pesticides				
Insecticide				$ 172.70
Herbicide				$ 99.60
Fungicide				$ 392.70
Nematicide				$ 138.60
Irrigation				$ 250.00
Labor (manual)				$ 222.53
Fuel / Machine Labor				$ 35.17
Other Costs (Staking and Tying)				$ 389.09
Interest on Operating Capital (9%)				$ 286.93
Total				$ 3,475.03
Harvest Operations	**Constant Cost per Acre ($)**	**Cost per Unit of Yield ($)**	**Yield**	**Total Cost per Acre ($)**
Labor		$ 0.13	1,365.00	$ 177.45
Hauling		$ 0.68	1,365.00	$ 928.20
Material		$ 0.80	1,365.00	$ 1,092.00
Grading / Packing / Storage		$ 1.69	1,365.00	$ 2,306.85
Other Costs				
Marketing Costs (8.5%)				$ 860.91
Total				$ 5,365.41

Worksheet 3-B(2b). Alternatives - Changes in Operating Costs

Alternative: Metam Sodium/Metam Potassium/Eggplant-2nd Crop

A	B	C	D	E
Operation / Input	Quantity Used per Acre	Units (lbs, hours, etc)	Unit Cost ($)	Total Cost per Acre ($)
Pre-plant Operations				
Land preparation				$ 9.75
Fumigation				
product (vapam between crops)	25	gallons/acre	$ 3.75	$ 93.75
application				$ 25.00
Irrigation				$ 50.00
Other costs				
Cultural Operations				
Seed / Seedlings				$ 185.00
Fertilizer / Soil Amendments				$ 232.88
Pesticides				
Insecticide				$ 172.70
Herbicide				$ 61.77
Fungicide				$ 392.70
Nematicide				$ 138.60
Irrigation				$ 250.00
Labor (manual)				$ 222.53
Fuel / Machine Labor				$ 35.17
Other Costs (Staking and Tying)				$ 95.94
Interest on Operating Capital (9%)				$ 176.92
Total				$ 2,142.71
Harvest Operations	Constant Cost per Acre ($)	Cost per Unit of Yield ($)	Yield	Total Cost per Acre ($)
Labor		$ 0.13	1,230.00	$ 159.90
Hauling		$ 0.68	1,230.00	$ 836.40
Material		$ 0.80	1,230.00	$ 984.00
Grading / Packing / Storage		$ 1.69	1,230.00	$ 2,078.70
Other Costs				
Marketing Costs (8.5%)				$ 492.43
Total				$ 4,551.43

Worksheet 3-A (3). Alternatives - Technical Feasibility of Alternatives to Methyl Bromide

Alternative: Methyl Iodide+Chloropicrin

1. Yield Loss & Pest Control When Comparing This Alternative to Methyl Bromide

Provide numerical estimates where possible.

Study # (list below)	Pest Being Tested	% Yield Loss *	% Pest Control *	Details
1	*Cyperus* Sp.	30-40	0	Feasibility covered in previous applications and attached studies.
2				
3				
4				
5				
Enter Average Loss				

* If no yield or quality loss information is given we will assume no losses. Only provide pest control information if yield or quality loss information is not available.

2. Study Information

For the information in #1 above list: the study name, authors, publication, date, and if a copy is attached.

Study #	Attached?	Details
1		see 2005 & 2006 applications
2	X	Cucumber Growth and Yield in Response to Halsulfuron
3	X	Infestation of Nutsedge Species in Georgia Vegetable Crops During 2003
4	X	Fumigant/Herbicide Combinations
5		

3. Quality Loss *

Describe quality impacts such as: percent smaller fruit, reduced grade, smaller plants, crop damage, disease vector, etc. **Refer to market category question in Worksheet 2-C.**

Market Category	Yield with Methyl Bromide	Units	Yield With Alternative	Units	Quality Impact Description
Fresh Mkt-Eggplant	1950	1 1/9 bu	1365	1 1/9 bu	smaller fruit, later harvest
Fresh Mkt- Eggplant	2050	1 1/9 bu	1230	1 1/9 bu	smaller fruit

4. Are there any production delays (planting/ harvesting) associated with this alternative?

Yes ☐ No ☐ (If yes, please explain) ____________

5. Are there any variety or cultivar issues associated with this alternative?

____

6. Restrictions on Alternative Use

This information will be used to determine the amount of methyl bromide needed.

	% of Area	Details
Regulatory Restriction		
- Label Restriction	100	Not currently labeled for use.
- Township Caps		
Soil Restriction		
Pest Resistant To Alternative		
Organic Matter Restriction		
Off Site Damage (outgassing)		
Other Restrictions (Describe)		

Worksheet 3-A(3). Alternatives - Technical Feasibility of Alternatives to Methyl Bromide

Alternative: Methyl Iodide + chloropicrin

7. Use Rate of Chemical Alternative

Active Ingredient (a.i.)	Name of Product and Formulation	Quantity a.i. per Acre	Units (gals, lbs. Etc.)	# of Acres Treated	# of Applications per Year
Methyl Iodide	Midas-98%	171.5	lbs.	NA	1
chloropicrin	2%	3.5	lbs.	NA	1

8. Non-Chemical Pest Control (please describe)

9. Alternative Timeline

(**Indicate when fumigation, major crop and pest management practices typically occur by shading the appropriate cells.** Show a second crop if part of the fumigation cycle. If the fumigation cycle is longer than one year change the months to an appropriate interval. These tables are for annual crops but more than one crop may benefit from one methyl bromide fumigation. If application covers multiple crops/crop groupings not grown sequentially, they will need to provide this information for all crops/crop groupings. Please adjust timeline as necessary. **Please provide additional comments or description below or on a separate page.** Please begin the timeline with the first land preparation. For **perennials**, please begin with the **year** of land preparation and fumigation and indicate the years of production by yield or percentage of full production.)

Beginning Fumigation Cycle	Time Interval (e.g. MONTH/YEAR/SEASON)											
	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
Land Preparation	X											
Fumigation	X											
Planting		X							X			
Harvest				X	X						X	X
Fallow						X	X					
Other Key Crop Steps								X				
Other Key Pest Steps								X				

Continuation of Alternative Cycle (if needed)	Time Interval (e.g. MONTH/YEAR/SEASON)											
	Month 13	Month 14	Month 15	Month 16	Month 17	Month 18	Month 19	Month 20	Month 21	Month 22	Month 23	Month 24
Land Preparation												
Fumigation												
Planting												
Harvest	X											
Fallow												
Other Key Crop Steps												
Other Key Pest Steps												

Comments:

First crop is terminated and a burndown herbicide plus Metam Sodium through drip irrigation may be applied between crops.

Reference for yield loss information: Weed Technology 16:860-866. Data is for cantaloupe, but would likely be even greater loss with cucumbers.

Worksheet 3-B(3). Alternatives - Changes in Operating Costs

Alternative: Methyl Iodide + chloropicrin/Eggplant

Enter all operating costs incurred during a fumigation cycle. Users with a relatively short fumigation cycle (less than five years) should use version B(1); users cultivating perennial crops should use version B(2). Users with multiple crops, either on the same area in a single fumigation cycle or on different areas treated separately, should copy this sheet and provide costs for each crop. If multiple crops are cultivated sequentially following a single fumigation, replace fumigation costs in pre plant Operations with any additional pest control costs used prior to the following crops. If a fallow season is an important part of the fumigation cycle, include costs incurred (for example, cultivating a cover crop) as a separate line or as a separate sheet, if costs are extensive. **Please fill in the unshaded areas. The shaded areas can be used if the information is known.**

Column A:	**Operation / Input** The operations/inputs listed here are not meant to be exhaustive or representative of your specific production system. They are meant to provide suggestions and to help you identify how your operation would change if methyl bromide were unavailable. Be as precise as necessary otherwise you may aggregate operations or inputs. For example, specify herbicide costs if additional treatments would become necessary with the use of a methyl bromide alternative, otherwise you may simply specify total pesticide costs. **Please specify only variable operating costs.**
	Operation / Input for Perennial Crops *For perennial crops (Worksheet B(2)), we have divided the lifespan into three basic periods: pre-production (including establishment), initial production, and full production. Please ensure that the timeline in Worksheet 3-A indicates the years of each period. Operating costs should be an average of costs incurred during each period. Please consider expected replanting rates and indicate which year dead or poorly performing young trees would be replaced. You may copy columns/rows as needed if these periods need to be refined for your situation.*
Column B:	**Quantity Used per Acre** This field is required only for methyl bromide. However, you may include specific amounts of other inputs or operations if you believe it helps to document the additional costs you would incur by using an alternative fumigant.
	Constant Cost per Acre For harvest operations, specify costs that depend on land area, for example, picking costs, per acre of land.
Column C:	**Units** *For all inputs and operations detailed in Column B, please specify the units of measurement.*
	Cost per Unit of Yield *For harvest operations, specify costs that depend on amount of product harvested, for example, packing material, per unit of produce.*
Column D:	**Unit Costs** For all inputs and operations detailed in Column B, please specify the unit cost. Also, indicate all costs of applying methyl bromide, including any material costs, for example, tarps. If custom applied and separate costs are unavailable, write 'custom' and enter total cost in Column E.
	Yield For harvest operations, indicate average yields or representative yields from Worksheet 3-A.
Column E:	**Total Cost per Acre** For inputs and operations detailed in Columns B and D, total costs can be calculated as Column B times Column D. Otherwise, enter total cost of the input or operation. As a check, you may add up Column E to obtain an estimate of total variable operating costs. These will not include fixed and overhead costs, nor a return to the owners' labor. It should, therefore, be less than gross revenues calculated in Worksheet 2-C. If it is not, please explain (for example, unusually poor yields or unusually poor prices). For perennial crops, Column E should only be totaled for the years at full production.
	Total Cost per Acre Harvest costs may likewise be calculated as costs per acre (Column B) plus variable costs per unit of yield (Column C) times yield (Column D).

Worksheet 3-B(3a). Alternatives - Changes in Operating Costs

Alternative: Methyl Iodide + chloropicrin/Eggplant

A	B	C	D	E
Operation / Input	Quantity Used per Acre	Units (lbs, hours, etc)	Unit Cost ($)	Total Cost per Acre ($)
Pre-plant Operations				
Land preparation				$ 50.00
Fumigation				
product (methyl iodide+chloropicri	175	lbs	$ 9.00	$ 1,575.00
application				$ 250.00
Irrigation				$ 50.00
Other costs				$ 415.58
Cultural Operations				
Seed / Seedlings				$ 185.00
Fertilizer / Soil Amendments				$ 255.88
Pesticides				
Insecticide				$ 172.70
Herbicide				$ 99.60
Fungicide				$ 392.70
Nematicide				$ 138.60
Irrigation				$ 250.00
Labor (manual)				$ 222.53
Fuel / Machine Labor				$ 35.17
Other Costs (Staking and Tying)				$ 389.09
Interest on Operating Capital (9%)				$ 403.37
Total				$ 4,885.22
Harvest Operations	Constant Cost per Acre ($)	Cost per Unit of Yield ($)	Yield	Total Cost per Acre ($)
Labor		$ 0.13	1,365.00	$ 177.45
Hauling		$ 0.68	1,365.00	$ 928.20
Material		$ 0.80	1,365.00	$ 1,092.00
Grading / Packing / Storage		$ 1.69	1,365.00	$ 2,306.85
Other Costs				
Marketing Costs (8.5%)				$ 860.91
Total				$ 5,365.41

Worksheet 3-B(3b). Alternatives - Changes in Operating Costs

Alternative: Methyl Iodide + chloropicrin-Eggplant-2nd Crop

A	B	C	D	E
Operation / Input	**Quantity Used per Acre**	**Units (lbs, hours, etc)**	**Unit Cost ($)**	**Total Cost per Acre ($)**
Pre-plant Operations				
Land preparation				$ 9.75
Fumigation				
product (vapam between crops)	25	gallons/acre	$ 3.75	$ 93.75
application				$ 25.00
Irrigation				$ 50.00
Other costs				
Cultural Operations				
Seed / Seedlings				$ 185.00
Fertilizer / Soil Amendments				$ 232.88
Pesticides				
Insecticide				$ 172.70
Herbicide				$ 61.77
Fungicide				$ 392.70
Nematicide				$ 138.60
Irrigation				$ 250.00
Labor (manual)				$ 222.53
Fuel / Machine Labor				$ 35.17
Other Costs (Staking and Tying)				$ 95.94
Interest on Operating Capital (9%)				$ 176.92
Total				$ 2,142.71
Harvest Operations	**Constant Cost per Acre ($)**	**Cost per Unit of Yield ($)**	**Yield**	**Total Cost per Acre ($)**
Labor		$ 0.13	1,230.00	$ 159.90
Hauling		$ 0.68	1,230.00	$ 836.40
Material		$ 0.80	1,230.00	$ 984.00
Grading / Packing / Storage		$ 1.69	1,230.00	$ 2,078.70
Other Costs				
Marketing Costs (8.5%)				$ 492.43
Total				$ 4,551.43

CUE 04-0050

CUCUMBER GROWTH AND YIELD IN RESONSE TO HALOSULFURON

Theodore M. Webster, Crop Protection and Management Research Unit, USDA-ARS, Tifton, GA (Twebster@tifton.usda.gov) and
A. Stanley Culpepper, Department of Crop and Soil Science, University of Georgia, Tifton.

The pending elimination of methyl bromide has created a significant challenge for growers to manage previously suppressed pests. Among the most challenging pests to manage in vegetable crops are purple nutsedge (*Cyperus rotundus*) and yellow nutsedge (*Cyperus esculentus*). Halosulfuron has been proposed as an alternative to methyl bromide for nutsedge management in many vegetable crops. While halosulfuron is very effective in controlling both nutsedge species, crop tolerance is often the factor limiting adoption of this tactic for a broad range of vegetable crops. The objective of these studies was to evaluate eggplant and cucumber tolerance to halosulfuron applied postemergence (POST) and through drip tape irrigation (DRIP).

Studies were conducted in Tifton, GA in the spring and fall of 2002 and 2003 (4 site-years). The soil was a Tifton Loamy Sand (83% sand, 9% silt, 7% clay) with <1% organic matter and pH 6.0. Plots were 7.6 m long and 1.8 m wide with a 0.76 m bed-top covered with 1.25-mil low-density polyethylene mulch. The study design was a randomized complete block with four replications. To minimize the effect of nematodes and soil-borne plant pathogens, the entire area was treated, two weeks prior to planting, with 133 kg ai/ha 1,3-dichloropropene and 75 kg ai/ha chloropicrin (1500 ppm injected through drip irrigation over six hours, and then flushed with water for one hour). The cucumber variety was 'Speedway'. With the exception of the nontreated control, the entire area was treated with halosulfuron at 39 g ai/ha through the drip tape irrigation prior to transplant. Following transplant, the following six treatments were imposed: halosulfuron POST at 26 g/ha applied at 1 week after transplant (WATr), 2 WATr, and 3 WATr; and halosulfuron applied at 26 g/ha DRIP at 1 WATr, 2 WATr, and 3 WATr. Early season plant growth (plant diameter) was measured prior to first harvest. As there were multiple harvests, data on fruit number and weight were organized into first harvest, second harvest, final harvest, and total cumulative harvest. Data were analyzed using analysis of variance and treatment means separated using Fisher's Protected $LSD_{0.05}$.

Cucumber plant diameter was reduced by all POST treatments and by the DRIP-1 WATr, relative to the nontreated control (Figure 1). Both of the other DRIP treatments and the PRE treatment had plant diameters similar to the nontreated control.

Cucumber fruit yield at the first harvest was lower in all POST treatments, relative to the nontreated control and all DRIP treatments (Figure 2). However by the second harvest, with exception to POST-1WATr, all treatments had yields equivalent to the nontreated control (Figure 3). The total cumulative cucumber yield was reduced for 1 WATr treatments (POST and DRIP) and POST-2WATr, relative to the nontreated control (Figure 4). All other treatments were equivalent to the nontreated control.

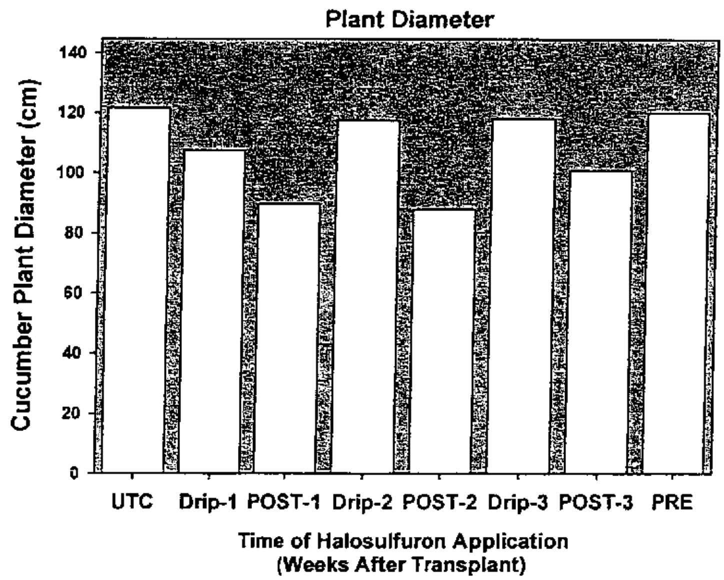

Figure 1. Cucumber plant diameter as affected by halosulfuron application. Treatment means were separated by Fisher's Protected $LSD_{0.05} = 11$.

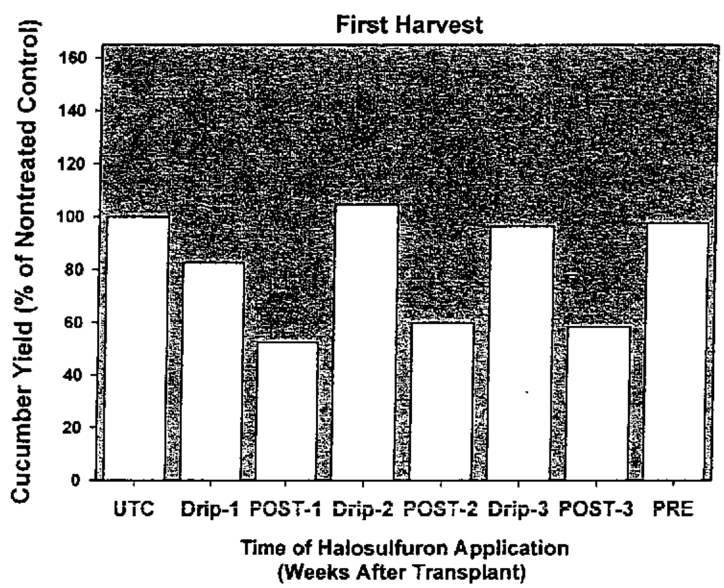

Figure 2. Cucumber yield data from the first harvest. Treatment means were separated by Fisher's Protected $LSD_{0.05} = 18$.

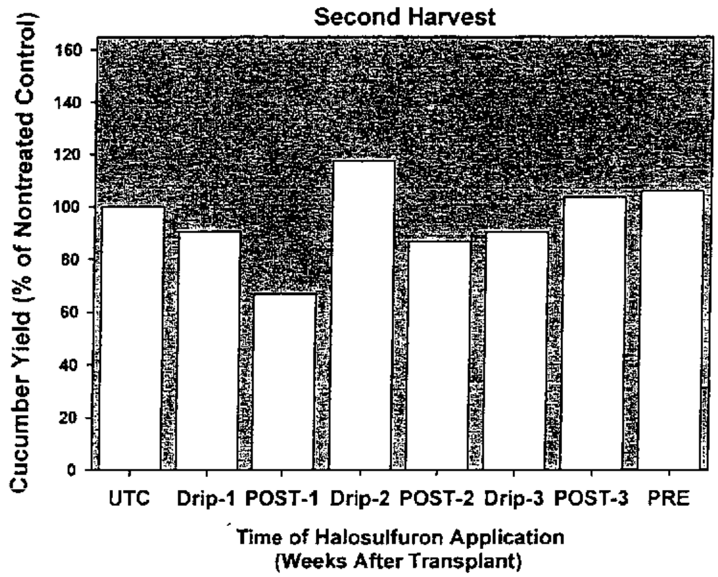

Figure 3. Cucumber yield data from the second harvest. Treatment means were separated by Fisher's Protected $LSD_{0.05} = 27$.

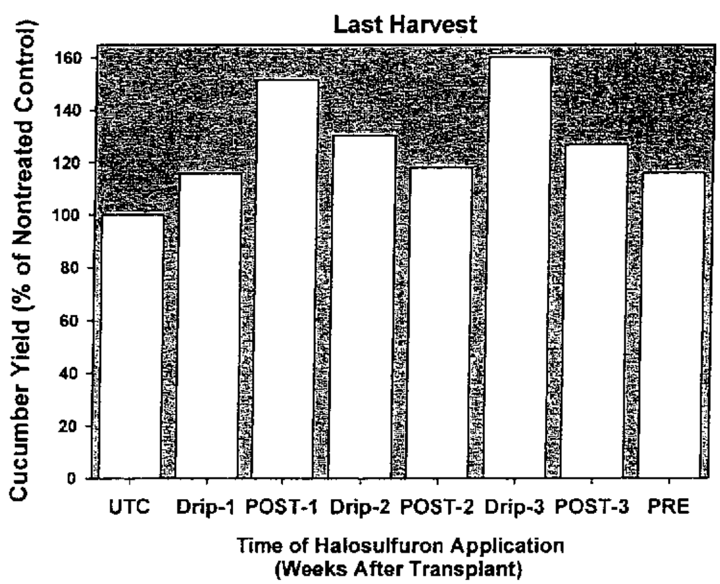

Figure 4. Cucumber yield data from the final harvest. Treatment means were separated by Fisher's Protected $LSD_{0.05} = 41$.

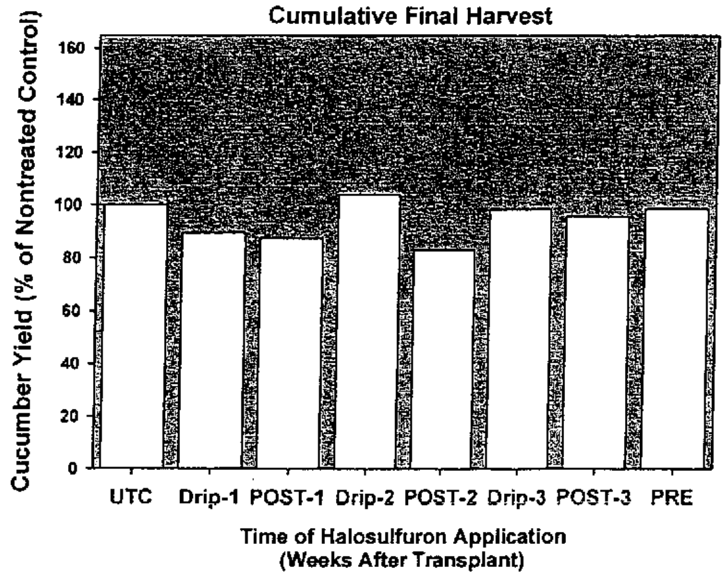

Figure 5. Cumulative cucumber yield harvest data. Treatment means were separated by Fisher's Protected $LSD_{0.05} = 10$.

These data indicate that halosulfuron may have a potential use in cucumber when applied through drip tape irrigation. This is significant because many growers are trying to grow multiple crops on the same polyethylene bed (e.g. a spring and then a fall crop). Many of the proposed alternatives to methyl bromide require a freshly prepared bed and the expense of new polyethylene mulch and drip tape irrigation. Additional research on application of halosulfuron through drip tape irrigation is needed before we can recommend this practice to growers.

CUE 04-0050

Infestation of Nutsedge Species In Georgia Vegetable Crops During 2003
A. S. Culpepper, Crop and Soil Science, University of Georgia

Fruiting vegetable and cucurbit crops account for the majority of plasiculture acres that utilize methyl bromide for pest control. Nutsedge species are the most troublesome weeds infesting Georgia fruiting vegetable crops and the fourth most troublesome weeds infesting Georgia cucurbit crops (Webster, 2002). Additionally, nutsedge species are the most common weed species infesting Georgia cucurbit and fruiting vegetable crops (Webster, 2002). A survey of 34 Georgia vegetable producing counties was conducted in 2003 to better understand the level of nutsedge infestation in cucurbit and fruiting vegetables. Results from counties included in this survey account for 71 to 89% of Georgia's total production in the respective crops (Table 1). The value of Georgia vegetables included in this survey represents over $206 million.

Table 1. Percent and Value of Georgia's Acreage Represented in this Survey.*

Crop (CUE Package)	Percent of Georgia Acres Represented	2002 Total Crop Value By CUE Crop	2002 Crop Value Represented in this Survey By CUE Crop
pepper	74	$57,905,678	$42,560,673
tomato	89	$25,085,474	$22,401,328
eggplant	85	$48,314,695	$41,067,491
squash	71	$9,930,587	$7,080,508
melon	88	$54,509,572	$47,695,876
cucumber	80	$56,665,121	$45,388,762
total			$206,214,638

*Crop values are from 2002 Georgia Farm Gate Value Report (AR 03-01).

Currently, methyl bromide is the fumigant option of choice and even with the use of methyl bromide on most of our acreage, nutsedge is still a serious pest. Moderate (5 to 30 plants per square yard) nutsedge infestations are noted on 39 to 43% of our tomato, eggplant, and melon acreage with infestations noted on 52 to 66% of our pepper, squash and cucumber acreage (Table 2). Severe (>30 plants per square yard) nutsedge plant populations often exceed 100 plants per yard square and are present on 7 to 23% of our acreage.

Table 2. Percent Current Nutsedge Infestation in Georgia Counties While Methyl Bromide is Available.*

Crop	No Infestation	Light Infestation	Moderate Infestation	Severe Infestation
pepper	1.3	18.9	65.6	14.2
tomato	0.7	49.0	43.0	7.3
eggplant	1.0	40.6	39.0	19.4
squash	1.6	31.3	52.3	14.8
melon	8.4	30.3	38.8	22.5
cucumber	2.7	26.4	58.9	12.0

*No infestation = no nutsedge infesting production area
*Light infestation = < 5 nutsedge plants per square yard
*Moderate infestation = 5 to 30 nutsedge plants per square yard
*Severe infestations = >30 nutsedge plants per square yard

Methyl bromide is an effective option in controlling nutsedge species, yet 50 to 80% of our current acreage is infested with moderate to severe levels of nutsedge. With the loss of methyl bromide, our survey suggest 82 to 91% of our acreage (Table 3) will have a moderate to severe nutsedge infestation the year following the loss of methyl bromide because of the intense ability of nutsedge to reproduce (Webster, 2003).

Table 2. Percent Anticipated Nutsedge Infestation The Year After the Inability to Use Methyl Bromide.*

Crop	No Infestation	Light Infestation	Moderate Infestation	Severe Infestation
pepper	0.0	9.1	31.6	59.3
tomato	0.5	9.6	66.2	23.7
eggplant	0.2	11.9	50.3	37.6
squash	0.9	10.5	40.7	47.9
melon	4.7	13.8	39.7	41.8
cucumber	1.9	8.7	52.0	37.4

*No infestation = no nutsedge infesting production area
*Light infestation = < 5 nutsedge plants per square yard
*Moderate infestation = 5 to 30 nutsedge plants per square yard
*Severe infestations = >30 nutsedge plants per square yard

Webster, T. M. 2002. Weed survey – southern states. pp. 202-288. *In* P. Dotray (ed.) 55th Proc. South. Weed Sci. Soc., Atlanta, GA. 28-30 Jan. 2002. South. Weed Sci. Soc., Champaign, IL.

Webster, T.M. 2003. Nutsedge (*Cyperus* spp.) eradication: impossible dream? In: Riley, L.E. R.K. Dumroese, and T.D. Landis, Tech. Coord. National Proceedings: Forest and Conservation Nursery Assoc. - 2002. Ogden, UT:USDA Forest Service, Rocky Mountain Research Station. Proceedings RMRS-P-25:21-25. Available at: http://www.fs.fed.us/rm/pubs/rmrs_p028.pdf

CUE 04-0050

FUMIGANT/HERBICIDE COMBINATIONS
A.S. Culpepper and D.B. Langston, University of Georgia, Tifton.

The pending elimination of methyl bromide has created a significant challenge for growers to manage previously controlled pests. Among the most challenging pests to manage in vegetable crops are purple nutsedge (*Cyperus rotundus*), yellow nutsedge (*Cyperus esculentus*), and southern root knot nematodes (*Meloidogyne incognita*).

Research has shown that several soil fumigants may be effective as replacements for methyl bromide (Lacascio et al. 1997; Melichar et al.1995; Noling et al. 2000; Rosskopf et al. 1999). However, results from these studies are extremely inconsistent. The alternatives that have been explored include metham-sodium, 1,3-dichloropropene, chloropicrin, combinations of these compounds, and methyl iodide. Although other potential soil fumigant alternatives exist, these compounds have received most of the attention and appear to be at the forefront of soil fumigants expected to partially replace methyl bromide. These fumigants perform inconsistently in research efforts but their use in an integrated management system utilizing cultural practices, various mulches, and herbicides may result in effective methyl bromide alternatives.

Studies were conducted in Tifton, GA at two sites during the spring of 2003 and one site in the fall of 2004. The soil was a Tifton Sandy Loam (92-94% sand, 2-3% silt, and 4-5% clay) with <1% organic matter with a pH between 6.2 and 6.8. Plots were 1 bed by 20 foot long and 32 inches wide covered with either a low density polyethylene film [LDPE(spring)] or a low density polyethylene film or virtually impermeable film [VIF (fall)]. The pepper cultivar Stiletto and the watermelon cultivar Margarita were transplanted 18 to 25 days after laying plastic. Nematode samples were taken at harvest and evaluated at the University of Georgia Nematode Lab in Athens, GA. Watermelons were harvested a single time while pepper were harvested three times and graded according to proper size and width requirements (ie jumbo, large, medium, small). Data were analyzed using analysis of variance and treatment means were separated using Fisher's Protected LSD at $P = 0.05$.

<u>Results and Discussion with Metam Fumigant Treatments</u>

Metam-sodium (or potassium) often controls soil-borne pathogens, nematodes, soil insects, and weeds (Anonymous, 1993; Anonymous, 2000; Thomson, 1991). Metam-sodium applied to moist soil will degrade to methyl isothiocyanate, which has biocidal activity (Braun and Supkoff, 1994). Although often effective, metam-sodium has not always provided control of soil-borne pathogens and other pests that is consistent and comparable to methyl bromide (Langston, unpublished data; Stall, 2000). Additionally, diseases such as those caused by *Fusarium* and *Verticillium* spp. are not controlled by this fumigant. Conventional methods of application of this fumigant often do not provide uniform distribution of pesticide in the soil (Gullino, 1992). Thus, the chemical does not disperse well throughout the soil and requires water for adequate movement (Anonymous, 1993; Munnecke and Van Gundy, 1979). Therefore, it's poor dispersion through the soil may limit the control of many pests including nutsedge species which often emerge from the top five inches of the soil profile (Siriwardana and Nishimoto, 1987).

Our research compared metam in combination with Telone II for the control of nutsedge and nematodes (Tables 1-3). In the fall of 2003, when both yellow and purple nutsedge were present and measured independently, metam plus Telone was 36% less effective than methyl bromide for the control of purple nutsedge. Interestingly, metam plus Telone was as effective as methyl bromide in the control of yellow nutsedge. This data suggest that purple nutsedge is significantly more tolerant to metam than yellow nutsedge. The addition of a herbicide program with the metam combination improved control of yellow nutsedge but again control of purple nutsedge was poor (Table 3). The herbicide program of Command/Dual Magnum/Devrinol does have activity on yellow nutsedge but is ineffective on purple nutsedge. No herbicide currently labeled for use on pepper, squash, or watermelon will provide control of purple nutsedge in the bed. Metam combinations generally controlled nematodes as well as methyl bromide.

Although metam plus Telone II is currently one of our leading alternatives for the control of yellow nutsedge, there are several issues with applying metam safely. To obtain adequate nutsedge control to date, metam has been applied to the soil surface and then immediately incorporated 3 to 4 inches into the soil followed immediately by the plastic laying operation. Treatments of disking the metam into the soil were not adequately effective. Our problem with applying metam to the soil surface and tilling into the soil thus far has been worker exposure. We have quickly determined that we would never apply or recommend metam be applied using this method because of worker exposure. Because we know metam can be effective on nutsedge and because we know we can not apply metam to the soil surface and incorporate it into the soil, we have built a new applicator device in an effort to address the worker exposure issue. We used this applicator for the first time during the fall of 2004. The device appeared to eliminate the worker exposure issues but it is yet to be determined how effective this method of application is for the control of nutsedge.

Results and Discussion with Chloropicrin Fumigant Treatments
Chloropicrin (e.g., Tear Gas) controls nematodes, bacteria, fungi, and some weeds. Although weed and nematode control has been noted with this product, it is not as effective as methyl bromide (Anonymous, 1993; Harris, 1991). In Georgia, chloropicrin alone does not provide adequate control of nematodes and must be in combination with a Telone product. In our trials, Telone II followed by chloropicrin and Telone C35 followed by chloropicrin were shanked injected. Additionally in two trials, Inline (Telone + chloropicrin) was drip injected.

Inline provided poor nutsedge control and lower yields when compared to methyl bromide (Tables 1, 2, and 3). Inline drip injected is clearly not an alternative to methyl bromide.

Following trends in the literature with shank injections of Telone and chloropicrin, these treatments were variable. In the spring pepper trial the aforementioned treatments were as effective as methyl bromide for the control of nutsedge species. However, in the spring watermelon trial these combinations contained 4.5 to 9.5 times more nutsedge than methyl bromide. In the fall, Telone II followed by chloropicrin was 44% and 58% less effective in controlling yellow and purple nutsedge, respectively, when compared to methyl bromide. The application of Telone C35 followed by more chloropicrin in the bed was as effective as methyl bromide in the fall trial. Yields were similar in the chloropicrin treatments and the methyl bromide treatments.

Adding a herbicide program to the chloropicrin combinations improved weed control in most instances and control was similar to that of methyl bromide applied alone. Similarly, when applying the chloropicrin combinations under VIF film during the fall of 2003, nutsedge control was enhanced in nearly every situation.

Results and Discussion with Telone Fumigant Treatments

1,3-dichloropropene (e.g., Telone) is as efficacious as methyl bromide in controlling nematodes, but is often not as effective in controlling weeds or fungi (Stall, 2000). Because Telone does not control nutsedge species, the fumigant was applied in combinations with either metam or chloropicrin in our work as previously discussed. Telone treatments generally controlled nematodes similar to methyl bromide.

Results and Discussion with Methyl Iodide Fumigant Treatments

Methyl iodide is pending registration and often controls nematodes, diseases, as well as nutsedge species. However, researchers have found that methyl iodide suppressed purple nutsedge growth during the early part of the growing season, however by the final pepper harvest there were no differences between methyl iodide and the nontreated control (Webster et al., 2001).

Results from our three trials indicated that methyl iodide was as effective in controlling nutsedge (predominately yellow) in the spring crop as well as yellow nutsedge in the fall crop (Tables 1, 2, 3). However, control of purple nutsedge in the fall study was extremely poor as previously reported (Webster et al., 2001). Methyl iodide provided 36% less purple nutsedge control than methyl bromide in the fall pepper trial (Table 3). The addition of the herbicide system did not improve nutsedge control as there is no herbicide program available to help manage purple nutsedge in pepper. Methyl iodide controlled nematodes similar to methyl bromide in the watermelon test in spring of 2003 and in the pepper test conducted in the fall of 2003. However, methyl iodide was the only treatment in the spring 2003 pepper trial that did not significantly suppress nematode populations when compared to the nontreated plots (Table 1).

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Table 1. Nutsedge, nematode, and pepper yield responses to methyl bromide alternatives during the spring of 2003.[1]					
Fumigant[2]	Nutsedge emerged through plastic at harvest (# per plot)[3]		Root Knot Nematodes	Total pepper yields (lbs/plot) [sum of all harvest dates and pepper classifications]	
	No Herbicide	Command + Dual Magnum + Devrinol[4]	Nematodes/100 cm^3	No Herbicide	Command + Dual Magnum + Devrinol[2]
Methyl bromide	47 abc	14 a	0 b	165 a	173 a
Telone II fb chloropicrin	174 cde	40 abc	0 b	151 a	158 a
Telone C35 fb chloropicrin	71 abc	58 abc	0 b	167 a	169 a
Telone C35 fb metam	157 cd	14a	0 b	150 a	174 a
Inline	255 de	71 abc	0 b	150 a	154 a
Methyl iodide	41 abc	22 ab	100 ab	145 a	150 a
None	297 e	106 bc	307 a	95 b	95 b

[1]Values followed by the same letter within nutsedge populations, within nematodes, and within yield are similar at $P = 0.05$. Black low density polyethylene film was used for all treatments. Plots were one bed (32 inch wide) by 20 feet.

[2]Methyl bromide (67:33) at 400 lb/A (broadcast rate) applied on a 44% band at a depth of 6-8 inches with a super bedder.
Telone II at 12 GPA (broadcast rate) on a 44% band at a depth of 10-12 inches deep with a Yetter rig.
Telone C35 applied at 35 GPA (broadcast rate) on a 44% band at a depth of 10-12 inches.
Chloropicrin applied at 150 lb/A (broadcast rate) on a 44% band at a depth of 6-8 inches with a super bedder.
Inline applied at 35 GPA (broadcast rate) on a 44% band through the drip (single line per 32 inch bed top).
Methyl Iodide (98:2) applied at 175 lb/A (broadcast rate) on a 44% band at a depth of 6-8 inches with a super bedder.
Metam applied at 46 GPA broadcast (6 foot) and pulled into a 32 inch bed.

[3]Nutsedge population in this trial contained 70% yellow nutsedge and 30% purple nutsedge.

[4]Herbicide system applied preemergence after bed forming and just prior to laying plastic.

Table 2. Nutsedge, nematode, and watermelon yield responses to methyl bromide alternatives during the spring of 2003[1].

Fumigant[2]	Nutsedge emerged through plastic at harvest (# per plot)[3]		Root Knot Nematodes	Total watermelon yields (lbs/plot) [sum of all harvest dates and pepper classifications]	
	No Herbicide	Command + Sandea[4]	Nematodes/100 cm[3]	No Herbicide	Command + Sandea[2]
Methyl bromide	29 a	4 a	0 a	239 a	228 a
Telone II fb chloropicrin	138 b	5 a	0 a	259 a	254 a
Telone C35 fb chloropicrin	280 c	7 a	1.3 a	276 a	250 a
Telone C35 fb metam	19 a	5 a	9.3 a	314 a	250 a
Methyl iodide	20 a	6 a	0 a	243 a	246 a
None	667 e	547 d	0 a	234 a	274 a

[1]Values followed by the same letter within nutsedge populations, within nematodes, and within yield are similar at P = 0.05. Black low density polyethylene film was used for all treatments. Plots were one bed (32 inch wide) by 20 feet.

[2]Methyl bromide (67:33) at 400 lb/A (broadcast rate) applied on a 44% band at a depth of 6-8 inches with a super bedder.
Telone II at 12 GPA (broadcast rate) on a 44% band at a depth of 10-12 inches deep with a Yetter rig.
Telone C35 applied at 35 GPA (broadcast rate) on a 44% band at a depth of 10-12 inches.
Chloropicrin applied at 150 lb/A (broadcast rate) on a 44% band at a depth of 6-8 inches with a super bedder.
Methyl Iodide (98:2) applied at 175 lb/A (broadcast rate) on a 44% band at a depth of 6-8 inches with a super bedder.
Metam applied at 46 GPA broadcast (6 foot) and pulled into a 32 inch bed.

[3]Nutsedge population in this trial contained 90% yellow nutsedge and 10% purple nutsedge.

[4]Herbicide system applied preemergence after bed forming and just prior to laying plastic. Sandea is not labeled for this use.

Table 3. Nutsedge and nematode responses to methyl bromide alternatives during the fall of 2003.[1]

Fumigant[2]	Percent Nutsedge Control[3]								Root Knot Nematodes	
	Yellow Nutsedge				Purple Nutsedge				Nematodes/100 cm^3	
	No Herbicide		+ Herbicide[4]		No Herbicide		+ Herbicide[4]			
	LDPE	VIF	LDPE	VIF	LDPE	VIF	LDPE	VIF	LDPE	VIF
Methyl bromide	77 bc	^	95 a	^	73 bc	^	88 ab	^	15 b	^
Telone II fb chloropicrin	33 ef	88 ab	72 c	99 a	15 hi	47 de	47 de	99 a	6 b	0 b
Telone C35 fb chloropicrin	87 ab	88 ab	96 a	99 a	60 cd	63 cd	70 bc	99 a	0 b	0.7 b
Telone C35 fb metam	65 cd	^	88 ab	^	37 fg	^	43 ef	^	15 b	^
Inline	20 f	35 e	33 ef	78 bc	7 i	22 ghi	25 g-i	63 cd	9 b	0 b
Methyl iodide	77 bc	^	93 a	^	37 fg	^	60 cd	^	3 b	^
None	0*	55 d	57 d	78 bc	0*	33 fgh	23 ghi	48 de	57 a	14 a

[1]Values followed by the same letter within nutsedge species are similar at P = 0.05. LDPE = Low density polyethylene film, VIF = Virtually impermeable film. Plots were one bed (32 inch wide) by 20 feet.

[2]Methyl bromide (67:33) at 400 lb/A (broadcast rate) applied on a 44% band at a depth of 6-8 inches with a super bedder.
Telone II at 12 GPA (broadcast rate) on a 44% band at a depth of 10-12 inches deep with a Yetter rig.
Telone C35 applied at 35 GPA (broadcast rate) on a 44% band at a depth of 10-12 inches.
Chloropicrin applied at 150 lb/A (broadcast rate) on a 44% band at a depth of 6-8 inches with a super bedder.
Inline applied at 35 GPA (broadcast rate) on a 44% band through the drip (single line per 32 inch bed top).
Methyl Iodide (98:2) applied at 175 lb/A (broadcast rate) on a 44% band at a depth of 6-8 inches with a super bedder.
Metam applied at 46 GPA broadcast (6 foot) and pulled into a 32 inch bed.

[3]Nutsedge population in this trial contained 70% yellow nutsedge and 50% purple nutsedge.

[4]Herbicide system of Command + Dual Magnum + Devrinol applied preemergence after bed forming and just prior to laying plastic.

^Treatment not included in trial.
*Number assigned value of 0, thus not included in the analysis.

Table 4. Pepper yield responses to methyl bromide alternatives during the fall of 2003[1]								
Fumigant[2]	Pepper Yield (# 28 lb boxes per acre)							
	Harvest 1 (Jumbo Fruit only)				Total Yield			
	No Herbicide		+ Herbicide		No Herbicide		+ Herbicide	
	LDPE	VIF	LDPE	VIF	LDPE	VIF	LDPE	VIF
Methyl bromide	213 b-g	^	281 a-e	^	1136 def	^	1620 ab	^
Telone II fb chloropicrin	216 b-g	290 a-e	355 a	194 c-g	1029 d-i	1191 cde	1242 cd	1770 a
Telone C35 fb chloropicrin	310 abc	219 b-g	219 b-g	169 fg	865 f-i	1033 d-i	1268 cd	1728 ab
Telone C35 fb metam	381 a	^	297 a-d	^	1104 d-g	^	1446 bc	^
Inline	329 ab	271 a-f	121 g	174 efg	842 g-h	778 hij	913 f-i	1055 d-h
Methyl iodide	174 efg	^	200 c-g	^	1041 d-i	^	1268 cd	^
None	121 g	161 fg	187 d-g	168 fg	515 j	758 ij	939 e-i	881 f-i

[1]Values followed by the same letter within harvest 1 and total yield are similar at P = 0.05. LDPE = Low density polyethylene film, VIF = Virtually impermeable film. Plots were one bed (32 inch wide) by 20 feet.

[2]Methyl bromide (67:33) at 400 lb/A (broadcast rate) applied on a 44% band at a depth of 6-8 inches with a super bedder.
Telone II at 12 GPA (broadcast rate) on a 44% band at a depth of 10-12 inches deep with a Yetter rig.
Telone C35 applied at 35 GPA (broadcast rate) on a 44% band at a depth of 10-12 inches.
Chloropicrin applied at 150 lb/A (broadcast rate) on a 44% band at a depth of 6-8 inches with a super bedder.
Inline applied at 35 GPA (broadcast rate) on a 44% band through the drip (single line per 32 inch bed top).
Methyl Iodide (98:2) applied at 175 lb/A (broadcast rate) on a 44% band at a depth of 6-8 inches with a super bedder.
Metam applied at 46 GPA broadcast (6 foot) and pulled into a 32 inch bed.

[3]Nutsedge population in this trial contained 50% yellow nutsedge and 50% purple nutsedge.

[4]Herbicide system applied preemergence after bed forming and just prior to laying plastic.

Worksheet 4. Future Research Plans

Please describe future plans to test alternatives to methyl bromide. You may use this worksheet to describe all future plans.

1. Identify the top 3 to 5 target pests for your research.

1	Yellow & Purple Nutsedge	4	Pythium sp.
2	Phytophthora capsici	5	Rhizoctonia solani
3	Nematodes		

2. Provide a list of alternative chemicals or cultural practices that have been tested.

1	1,3 - dichloropropene	4	Metam Potassium
2	chloropicrin	5	Methyl Iodide
3	Metam Sodium	6	Dual, Sandea, Devrinol

3. Prioritize the alternative chemicals or cultural practices to be tested.

1	Methyl Iodide	4	
2	1 ,3-D + Pic	5	
3	Metam Potassium + 1,3-D		

4. What would be the best currently available alternative if methyl bromide were not available?

1, 3 - Dichloropropene + Chloropicrin

Metam Potassium + 1, 3-D

5. Please provide an overview/timeline of the plan to transition away from using methyl bromide.

Currently there is no data to suggest that there is a suitable alternative to transition toward. Obviously, should a suitable alternative become available and prove technically and economically feasible, Georgia growers would transition away from methyl bromide as soon as feasible.

6. Will yield/quality loss be measured? Yes [X] No [ ]

7. Will economic impacts be measured? Yes [X] No [ ]

8. How will you minimize your use and/or emissions of methyl bromide?

(check all that apply)

- [X] **Formulation Changes (please specify)**
- [X] **Tarpaulin (Low Density Polyethylene)**
- [ ] **Virtually Impermeable Film (VIF)**
- [ ] **Other**
- [X] **Cultural Practices (please specify)** fallow management of nutsedge, crop rotation
- [X] **Other Pesticides (please specify)** Roundup, Sandea, Dual, Sulfentrazone, fumigants
- [ ] **Non-Chemical Methods (please specify)**

Formulation Changes

From: __98_% methyl bromide, ___2_% chloropicrin

To: __67_% methyl bromide, __33_% chloropicrin

This has already been accomplished.

9. What is the cumulative amount spent and the types of contributions this consortium has made to fund research to develop alternatives to methyl bromide since 1992? (e.g. consortium dues, direct research funding, etc.)

Years	Name of Organization / Research Institution	Amount ($)
93-03	University of Georgia	$773,000.00
93-03	USDA-Tifton Pest Control Unit	$1,970,000.00
93-03	GFVGA	$9,000.00
2003-04	University of Georgia	$94,050.00

10. Other total investments, if any, made to reduce your reliance on methyl bromide? $

(Describe each investment and its associated costs. e.g. specialized machinery, etc.)

Investment	Cost
Custom Drip Irrigation System for research	$30,000.00
Application Equipment	$106,500.00
Plastic, Fumigants, Drip Irrigation	$20,000.00

11. Grant requests made to USDA, EPA, state, or other funding group.

Methyl Bromide Alternatives-IR4

Methyl Bromide Alternatives-USDA

BIOFUMIGATION AS AN ALTERNATIVE TO METHYL BROMIDE: NUTSEDGE CONTROL

Theodore M. Webster, Crop Protection and Management Research Unit, USDA-ARS, Tifton, GA (Twebster@tifton.usda.gov)

A series of studies have been initiated by a group of scientists at the Coastal Plain Experiment Station in Tifton, GA. Funding has been provided by USDA-CSREES, Methyl Bromide Transitions Grant. Dr. K. Seebold is the principal investigator and the following scientists are collaborators:

- Dr. A.S. Csinos (Research Plant Pathologist)
- Dr. J. Desaeger (Research Nematologist)
- Dr. D. Langston (Extension Plant Pathologist)
- Dr. R. Gitaitis (Research Plant Pathologist)
- Dr. J. Diaz (Research Horticulturist)
- Dr. G. Fonsah (Extension Agricultural Economist)
- Dr. G. Rains (Research Agricultural Engineer)
- Dr. T. Webster (Research Weed Scientist).

The following tests were initiated in and around Tifton, GA in Spring 2004:

1. Evaluation of local and exotic brassicas for biogumigation potential
2. Evaluation of turnip and rutabaga green manure for biofumigation
3. Evaluation of green manure crops in combination with metam

Response of yellow nutsedge (*Cyperus esculentus*) and redroot pigweed (*Amaranthus retroflexus*) to green manure biofumigants is currently under investigation. To date, we have been unable to process and analyze all of the data from this spring's studies.

EVALUATE THE EFFECT OF SOIL CONDITIONS, PARTICULARLY SOIL TEMPERATURE AND MOISTURE, ON NUTSEDGE SPECIES EFFICACY FROM SEVERAL FUMIGANTS.

Principal Investigators:
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David B. Langston, Jr., University of Georgia - Plant Pathology Extension
Ted Webster, United States Department of Agriculture, Agricultural Research Service
Kenny Seebold, University of Georgia - Plant Pathology Research
Timothy L. Grey, University of Georgia - Weed Science Research
Greg Fonsah, University of Georgia - Agriculture Economics

Introduction and Study Parameters:
In Georgia, most growers fumigant the first three weeks of February in preparation for their spring crops. During this fumigation period, nutsedge control is often variable. Because of variable results, growers increase their use rates of methyl bromide to overcome potential variability We suspect the inconsistent control may be a response in varying soil temperatures and/or soil moisture. These climatic factors of the soil environment could affect the efficacy of the fumigation by hindering its movement throughout the soil profile. Another important component could be the relative dormancy of nutsedge tubers that is enforced by cool, moist soil conditions.

A study applying chloropicrin at 150 lb/A broadcast, methyl bromide at 263 lb/A broadcast (66% of normal use rate), and nontreated control will be applied at four timings (mid January, early February, mid February, and early March) to further understand the impacts of soil conditions on fumigant efficacy. Soil moisture and temperature devices will be set up to take measurements throughout the trial. Field sites with high naturalized populations of nutsedge will be selected. Nutsedge emergence will be measured in each plot throughout the season. Chloropicrin and a reduced rate of methyl bromide were selected as fumigant options to obtain only average control of nutsedge, thus allowing soil environment differences and their relations with fumigants for the control of nutsedge to be closely examined.

In an effort to test the effect of nutsedge tuber dormancy at the time of application, packets containing 50 tubers will be buried at the time of application. Three packets will be buried in each plot: a packet of dormant tubers, a packet of tubers imbibed under warm conditions for 48 hours, and packets imbibed under warm conditions for 168 hours. All packets will be recovered two to four weeks after the final fumigation. Tubers will be placed in potting media and placed under conditions that promote tuber sprouting and shoot emergence (Webster, 2003b). Treatment efficacy will be evaluated as an inverse function of nutsedge tuber viability. Results from this trial could improve grower ability to apply the fumigants at times where lower soil fumigant rates or less effective soil fumigants would provide adequate control of nutsedge. Results will also improve our understanding of how nutsedge tuber dormancy affects the efficacy of various fumigants and evaluate the suspected tuber-dormancy break caused by chloropicrin.

INVESTIGATE THE IMPACT OF MULTIPLE-SEASON ADOPTION OF METHYL BROMIDE ALTERNATIVES IN TERMS OF PEST SPECIES COMPOSITION, INCLUDING WEEDS, DISEASES, AND NEMATODES.

Principal Investigators:
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David B. Langston, Jr., University of Georgia - Plant Pathology Extension
Ted Webster, United States Department of Agriculture, Agricultural Research Service
Kenny Seebold, University of Georgia - Plant Pathology Research
Timothy L. Grey, University of Georgia - Weed Science Research
Greg Fonsah, University of Georgia - Agriculture Economics

Introduction and Study Parameters:
No current data is available on the long term effects on shifts in pest species composition for weeds, nematodes, and pathogens when methyl bromide alternatives are used several consecutive years on the same land area. Thus a study using eight fumigant options as listed below will be conducted over at least the next four years. One treatment has specifically been included in this study for the EPA to address the potential for using methyl bromide in alternate years. Each fumigant treatment will consist of either a no herbicide option or S-metolachlor + napropamide + clomazone at normal use rate. Each year pepper will be planted as the spring crop followed by a cucurbit as the fall crop.

Fumigant Year 1	Fumigant Year 2	Fumigant Year 3	Fumigant Year 4
None	None	None	None
Methyl Bromide	Methyl Bromide	Methyl Bromide	Methyl Bromide
Methyl Iodide	Methyl Iodide	Methyl Iodide	Methyl Iodide
1,3-D fb Chloropicrin	1,3-D fb Chloropicrin	1,3-D fb Chloropicrin	1,3-D fb Chloropicrin
1,3-D fb Chloropicrin	Methyl Bromide	1,3-D fb Chloropicrin	Methyl Bromide
1,3-D + Chloropicrin fb Chloropicrin	1,3-D + Chloropicrin fb Chloropicrin	1,3-D + Chloropicrin fb Chloropicrin	1,3-D + Chloropicrin fb Chloropicrin
1,3-D + Metam	1,3-D + Metam	1,3-D + Metam	1,3-D + Metam
Metam	Metam	Metam	Metam

INTEGRATION OF MULTIPLE TACTICS AS ALTERNATIVES TO METHYL BROMIDE FOR MANAGEMENT OF WEEDS, DISEASES, AND NEMATODES IN PEPPER AND EGGPLANT.

Principal Investigators:
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David B. Langston, Jr., University of Georgia - Plant Pathology Extension
Ted Webster, United States Department of Agriculture, Agricultural Research Service
Kenny Seebold, University of Georgia - Plant Pathology Research
Timothy L. Grey, University of Georgia - Weed Science Research
Greg Fonsah, University of Georgia - Agriculture Economics

Study Parameters:
A factorial arrangement of fumigants (9), herbicides (2), and plastic mulches (2) will be evaluated to determine the most effective combination of tactics to manage weeds, diseases, and nematodes. The nine fumigant options include: methyl bromide, two formulations of methyl iodide plus chloropicrin (trade name: Midas), 1,3-dichloropropene (trade name: Telone II) followed by chloropicrin, 1,3-dichloropropene plus chloropicrin (trade name: Telone C35) followed by chloropicrin, 1,3-dichloropropene followed by metham-potassium (trade name: K-Pam), an experimental fumingant (PI's under confidentiality agreement) applied with and without chloropicrin, and a nontreated control. These fumigants were selected based on preliminary data that suggest these options are the best soil fumigant alternatives to methyl bromide (Culpepper and Langston, 2004). Herbicide options selected were based on the only herbicides labeled or potentially labeled for use in pepper or eggplant. The two herbicide options will include in eggplant *S*-metolachlor plus napropamide and a nontreated control and in pepper *S*-metolachlor plus napropamide plus clomazone and a nontreated control. The two plastic mulch options will be the industry standard low density polyethylene mulch and a virtually impermeable film mulch (VIF).

Crop Response Measurements: Data will be collected throughout the season to assess crop vigor and response to these treatments. Visual estimates of crop injury, rated on a scale of 0 (no crop injury) to 100 (dead crop), will be evaluated in each plot multiple times throughout the growing season. Crop plant height and plant diameter will be measured every three to four weeks throughout the season to also determine crop vigor. Crops will be harvested and peppers will be graded for size using industry standards.

Nutsedge Response Measurements: Visual estimates of nutsedge control in each plot will be evaluated multiple times throughout the experiment using a scale of 0 (no control) to 100% (complete control). Additionally, nutsedge emerging through the plastic will be counted every three to four weeks. In an effort to test the effect of nutsedge tuber dormancy at the time of application, packets containing 50 tubers will be buried at the time of application. Three packets will be buried in each plot: a packet of dormant tubers, a packet of tubers imbibed under warm conditions for 48 hours, and packets imbibed under warm conditions for 168 hours. All packets will be recovered two to four weeks after fumigation, at the time when a crop will be transplanted. Tubers will be placed in potting media and placed under conditions that promote tuber sprouting and shoot emergence (Webster, 2003b). Treatment efficacy will be evaluated as an inverse function of nutsedge tuber viability.

Soil Fungi Measurements: Soil assays will be performed for each of the studies. Using a subsample from samples taken prior to planting, at planting, and at harvest, aliquots of soil will be removed from each subsample and air dried for 24 hours. Five grams of soil will be added to 100 ml of 0.3% water agar and mixed thoroughly. Immediately afterward, 1 ml of soil/agar will be removed and mixed with 20 ml of 0.3% water agar. One ml of the first preparation will be dispensed and spread evenly onto a petri plate containing an oomycete-selective medium (pimaricin-ampcillin-rifampicin-PCNB) for isolation of *Pythium* and *Phytophthora* spp (Jeffers and Martin, 1986). One ml of the second preparation will be dispensed and spread onto a petri plate containing a *Fusarium*-selective medium (peptone-PCNB) (Papavizas, 1967). Five plates per sample will be prepared for both media, and plates will be incubated for 72 hours prior to enumeration of fungal colonies. Fifteen 100 mg pellets of soil will be plated on five plates per sample containing a *Rhizoctonia solani*-semiselective medium for isolation of that fungal species (Henis et al., 1978; Sumner and Bell, 1982). A subset of *Pythium*, *Phytophthora*, *Rhizoctonia*, and *Fusarium* isolates will be identified to species and tested for pathogenicity on yellow squash seedlings in the greenhouse.

Pathogen survival will be evaluated by placing propagules (fungus-infested table beet seed) of *Fusarium solani* f.sp. *cucurbitum*, *Pythium irregulare*, *Rhizoctonia solani*, and *Phytophthora capsici* into 15 cm × 5 cm-nylon mesh bags and burying them in plots prior to application of treatments. Bags will be removed at transplanting and the propagules will be evaluated on semi-selective media to determine treatment effects on pathogen survival. Inoculations will be made on squash seedlings to determine effects on pathogenicity of fungi that survive the biofumigation process. Field incidence and severity of disease caused by soilborne pathogens will be taken at the onset of symptoms and will continue until harvest. Isolations will be made from diseased tissue to identify the causal agent(s).

EVALUATE VEGETABLE CROP RESPONSE TO HERBICIDES APPLIED UNDER PLASTIC PRIOR TO CROP TRANSPLANTS AND CHARACTERIZE HERBICIDE FATE WHEN APPLIED IN A PLASTICULTURE SYSTEM BETWEEN SUMMER AND FALL CROPS.

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Introduction and Study Parameters:
Research has noted applying glyphosate after the first crop and prior to the second crop reduced purple nutsedge infestations in the second crop. However, glyphosate has been shown to be more effective in controlling purple nutsedge than yellow nutsedge. There are other herbicides that may be more effective in controlling both species of nutsedges. However, there is no data on these herbicides to indicate the rate of degradation and/or susceptibility to wash-off from polyethylene mulch. Thus, studies are needed to determine the potential use of this herbicide application with glyphosate and other more effective nutsedge herbicides. Research is available on the ability to wash glyphosate and paraquat from the plastic, however no data is available on the ability to wash other herbicides from the plastic such as halosulfuron.

Experiment 1: **Evaluate crop response to the application of halosulfuron, glyphosate, paraquat, flumioxazin, and carfentrazone applied overtop of plastic prior to crop transplant.**
After applying these herbicides overtop of plastic, either 1) a rain event or 2) no rain event will follow addressing the potential for herbicides to be removed from the plastic prior to planting the crop. Immediately after herbicide application and rainfall or no rainfall, a squash and tomato crop (most sensitive crops) will be planted. Visual estimates of crop injury as well as measurements of crop height and diameter will be taken throughout the season. At seasons end, yield will be taken. Squash will be harvested at least three times a week for at least 30 days and tomato will be harvested at least once, and fruit separated by market grade. This trial will inform us if application of these herbicides overtop of polyethelene mulch for the control of emerged nutsedge prior to planting a crop is feasible.

Experiemnt 2: **Evaluate the degradation of halosulfuron, paraquat, glyphosate, carfentrazone, flumioxazin, and metolachlor on polyethylene mulch.**
After applying these herbicides overtop of mulch, one square foot sections of mulch will be harvested daily for at least one week. Samples will then be washed with solvents to remove any herbicide from the polyethylene mulch and then filtered prior to detection. Corning brand syringe filters with a diameter of 0.45 *u*m will be utilized to ensure accuracy. Using a Waters liquid chormatograph in tandem with a Micromass Quattro mass-spectrometry, the analysis will provide information on the dissipation through volatilization and photodegradation of these

herbicides when in contact with polyethylene mulch. This trial will support results of experiment 1 by informing scientist for the potential use of these herbicides over polyethylene mulch prior to planting.

Experiment 3: Evaluate the potential for halosulfuron, paraquat, glyphosate, carfentrazone, flumioxazin, and metolachlor to be washed from plastic mulch with rainfall or overhead irrigation.

These herbicides will be applied overtop of plastic mulch followed by daily irrigation. After each irrigation event, a one square foot section of polyethylene mulch will be harvested. Using the equipment and procedure previously described (Experiment 2) for herbicide analysis, this experiment will provide information on the ability of growers to wash these herbicides off polyethylene mulch with irrigation or rainfall prior to planting. The trial will support results of Study experiment 1 by informing scientist for the potential use of these herbicides over polyethylene mulch prior to planting.

EVALUATE VEGETABLE CROP RESPONSE TO HERBICIDES APPLIED UNDER PLASTIC PRIOR TO CROP TRANSPLANTS AND CHARACTERIZE HERBICIDE FATE WHEN APPLIED IN A PLASTICULTURE SYSTEM BETWEEN SUMMER AND FALL CROPS.

Principal Investigators:
A. Stanley Culpepper, University of Georgia - Weed Science Extension
David B. Langston, Jr., University of Georgia - Plant Pathology Extension
Ted Webster, United States Department of Agriculture, Agricultural Research Service
Kenny Seebold, University of Georgia - Plant Pathology Research
Timothy L. Grey, University of Georgia - Weed Science Research
Greg Fonsah, University of Georgia - Agriculture Economics

Introduction and Study Parameters:
Research has noted applying glyphosate after the first crop and prior to the second crop reduced purple nutsedge infestations in the second crop. However, glyphosate has been shown to be more effective in controlling purple nutsedge than yellow nutsedge. There are other herbicides that may be more effective in controlling both species of nutsedges. However, there is no data on these herbicides to indicate the rate of degradation and/or susceptibility to wash-off from polyethylene mulch. Thus, studies are needed to determine the potential use of this herbicide application with glyphosate and other more effective nutsedge herbicides. Research is available on the ability to wash glyphosate and paraquat from the plastic, however no data is available on the ability to wash other herbicides from the plastic such as halosulfuron.

Experiment 1: **Evaluate crop response to the application of halosulfuron, glyphosate, paraquat, flumioxazin, and carfentrazone applied overtop of plastic prior to crop transplant.**
After applying these herbicides overtop of plastic, either 1) a rain event or 2) no rain event will follow addressing the potential for herbicides to be removed from the plastic prior to planting the crop. Immediately after herbicide application and rainfall or no rainfall, a squash and tomato crop (most sensitive crops) will be planted. Visual estimates of crop injury as well as measurements of crop height and diameter will be taken throughout the season. At seasons end, yield will be taken. Squash will be harvested at least three times a week for at least 30 days and tomato will be harvested at least once, and fruit separated by market grade. This trial will inform us if application of these herbicides overtop of polyethelene mulch for the control of emerged nutsedge prior to planting a crop is feasible.

Experiemnt 2: **Evaluate the degradation of halosulfuron, paraquat, glyphosate, carfentrazone, flumioxazin, and metolachlor on polyethylene mulch.**
After applying these herbicides overtop of mulch, one square foot sections of mulch will be harvested daily for at least one week. Samples will then be washed with solvents to remove any herbicide from the polyethylene mulch and then filtered prior to detection. Corning brand syringe filters with a diameter of 0.45 *u*m will be utilized to ensure accuracy. Using a Waters liquid chormatograph in tandem with a Micromass Quattro mass-spectrometry, the analysis will provide information on the dissipation through volatilization and photodegradation of these

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OMB Control # 2060-0482
For EPA Use Only ID # 04-0050
SECTOR ____

Worksheet 5. Application Summary

This worksheet will be posted on the web to notify the public of requests for critical use exemptions beyond the 2005 phase out for methyl bromide. Therefore, this worksheet cannot be claimed as CBI.

1. Consortium Name: Georgia Fruit and Vegetable Growers Association

2. Location: Georgia

3. Crop: Eggplant followed by Eggplant (or some other second crop)

4. Pounds of Methyl Bromide Requested **2007** **107,736** **lbs.**

5. Acres Treated with Methyl Bromide **2007** **804** **Acres**

6. *If methyl bromide is requested for additional years, reason for request:*

There is no forseeable alternative to methyl bromide that will be technically and economically feasible for production of these crops by 2006 or 2007. Therefore, requests are being made to cover these years as well.

2006	107,736	**lbs.**	**Area Treated**	804	**Acres**
2007	107,736	**lbs.**	**Area Treated**	804	**Acres**
2008	107,736	**lbs.**	**Area Treated**	804	**Acres**

Place an "X" in the column(s) labeled "Not Technically Feasible" and/or "Not Economically Feasible" where appropriate. Use the "Reasons" column to describe why the potential alternative is not feasible.

Potential Alternatives	Not Technically Feasible	Not Economically Feasible	Reasons
Telone (1, 3-Dichloropropene)	X		Product will not control nutsedge, a major pest in GA. Not legal to use this material where Karst topography exists.
Chloropicrin	X		Does not adequately control nutsedge or nematodes
Metam Sodium	X		Does not adequately control nutsedge. Also, has a 21-day waiting period before planting.
Metam Potassium	X		Does not adequately control nutsedge. Also, has a 21-day waiting period before planting.
Methyl Iodide	X		Does not adequately control nutsedge and not currently labeled.
Solarization	X		Does not adequately control nutsedge.
General IPM	X		Does not adequately control nutsedge.
Organic Production	X		Does not adequately control nutsedge.
Biological Control	X		Does not adequately control nutsedge.
Resistant Cultivars	X		Does not adequately control nutsedge.
Cover Crops & Mulching	X		Does not adequately control nutsedge.